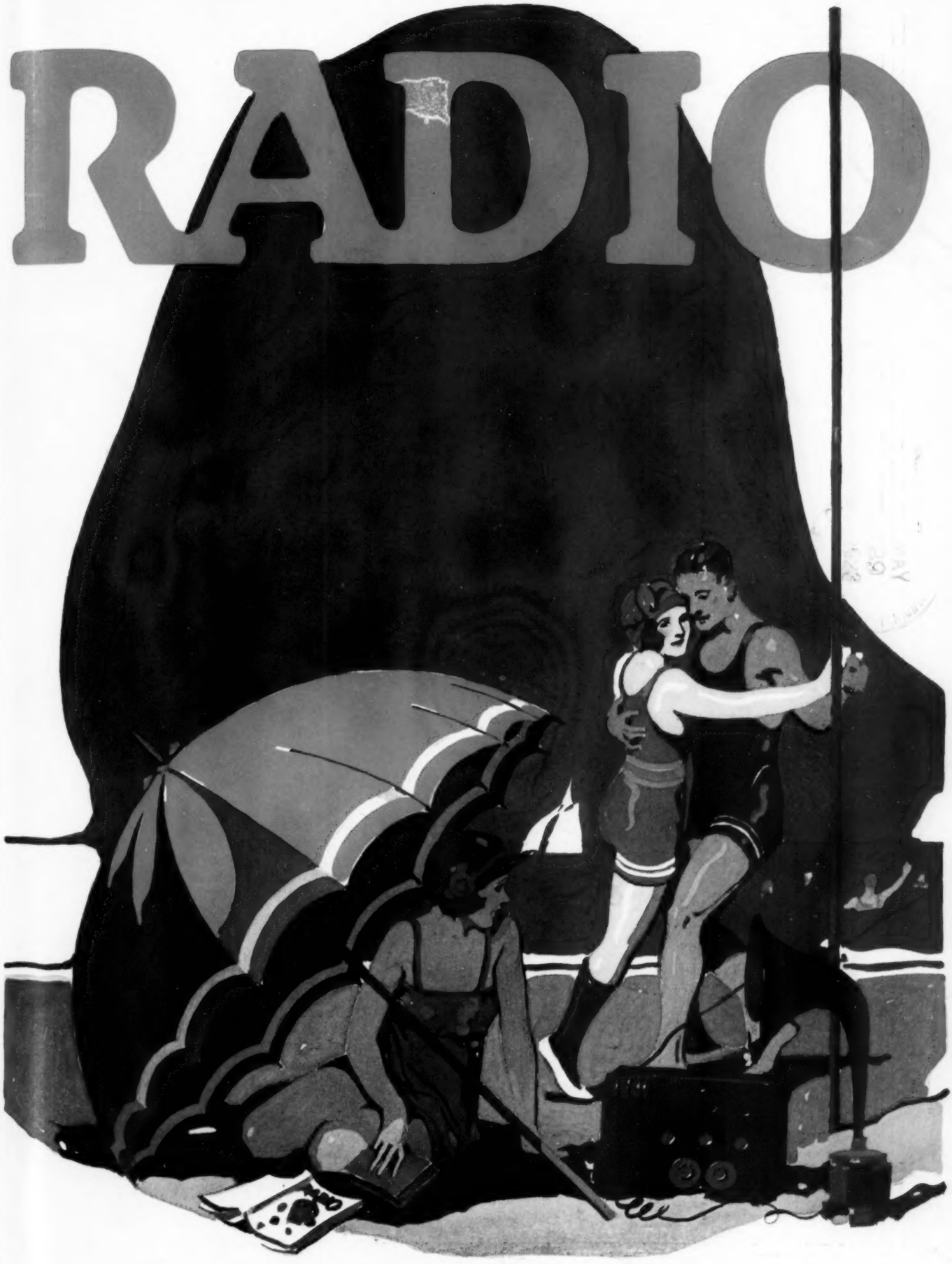
JUNE 1923 25 Cents

RADIO



MAKE THIS A RADIO SUMMER

Filament Current .06 amp. Mutual Conductance 337 Micromhos at 40 volts plate and 0 grid potential.

Cut shows actual size of tube 3 inches high

Type C-299
Price $6.50

Announcing the New

Cunningham

Dry Battery Detector and Amplifier Tube

Designed by the engineers of the General Electric Company's great research laboratories, this new dry battery tube, type C-299, is by far the most economical vacuum tube ever placed on the market for amateur, experimental and entertainment use.

It has been designed for use as a Detector and Amplifier of both radio and audio-frequency currents. The filament is lighted from three 1½ volt dry batteries in series, and the filament current is only .06 of an Amp. This is less than one fourth of the current of any previous type of dry battery tube. This feature makes it possible to use four of these tubes in parallel, with only one set of three dry batteries.

The C-299 has practically the same operating characteristics as the previous Cunningham Amplifier, type C-301. Due to the low distributive capacity of the elements it is an excellent radio-frequency amplifier. When used as an audio-frequency amplifier the output from two steps is sufficient for the operation of a small loud speaker.

Bulletin No. 2-R describes this new tube in full and gives the necessary data regarding rheostats, battery voltages, transformers, etc. A free copy will be sent to you by return mail, upon receipt of your request at either of the addresses given below. Complete instruction sheet for its care and operation is packed with each of these New Cunningham Dry Battery Tubes, type C-299.

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E. J. Cunningham

154 W. Lake Street
Chicago, Illinois

Paul F. Godley's Amazing Experience With

BURGESS
RADIO BATTERIES

PARAGON RADIO PRODUCTS
GENERAL OFFICES & FACTORY
UPPER MONTCLAIR, N.J.
November 29, 1922

Mr. Duncan Keith, Vice-President,
Burgess Battery Company,
Chicago, Illinois.

Dear Mr. Keith:

In reply to yours of the 21st of November, I am always pleased to recommend a first-class article.

A year ago this month I received a shipment of Burgess Batteries for use in conjunction with my reception of American amateur signals in Scotland. These batteries were taken to Scotland, used for ten days while actually setting in the mud underneath a rough table which carried the apparatus. They gave entire satisfaction during all this time. Some of these were brought back to the United States and purposely left outside my home all during the summer in sun and rain. Last night I connected them into circuit connection with the regenerative receiver and two-stage amplifier. They functioned perfectly. I am sending one of these batteries to you by parcel post and should be glad to have you take it and place it in your "museum".

Knowing "B" batteries as I do, I consider this as a very remarkable one.

I am,

Yours very truly,
Paul F. Godley

PFG:IS

TWICE across the stormy Atlantic, engulfed in oozing mud, and exposed for months to the destructive action of the elements, Paul Godley's set of BURGESS Radio Batteries, wind-swept, rain drenched and sun-scorched though they were, responded instantly and powerfully, with the vital energy necessary to the perfect operation of his delicate receiving set.

While it is seldom that a radio battery is required to function under the stress of conditions a fraction as difficult as these, Paul Godley's experience stands out as a remarkable and heretofore unheard-of example of the long life, high capacity, tenacity of power and indestructible construction of Burgess Batteries—*enduring qualities that are built in.*

BURGESS BATTERY COMPANY

Engineers—DRY BATTERIES—Manufacturers
FLASHLIGHT—RADIO—IGNITION—TELEPHONE

General Sales Office: Harris Trust Bldg., Chicago
Laboratories and Works: Madison, Wisconsin

BRANCHES:
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KANSAS CITY ST. PAUL NEW ORLEANS

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Winnipeg Toronto Montreal

"ASK ANY RADIO ENGINEER"

RADIO

Established 1917 as Pacific Radio News

Volume V *for* JUNE, 1923 *Number 6*

CONTENTS *for* JUNE, 1923

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LAWRENCE MOTT . . . . . *Associate Editor*
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Forecast of Contributions for July Issue

C. M. Jansky, professor of electrical engineering at the University of Wisconsin, and member of the National Radio Conference, in his article on " Broadcasting and Its Future" presents a thoughtful and illuminating analysis of the subject.

An interesting and helpful discussion of "The Technique of D. X. Reception" is given by Carl Dreher. He shows that it is really the operator rather than the instrument that determines the range of a receiving set.

For the amateur constructor Lawrence F. Emmons describes how to make a cheap crystal outfit which is made especially selective by the use of spiderweb coils.

Bernard Steinmetz in an article on "Radio Frequency Measurements with a Wheatstone Bridge" tells how the experimenter can determine the constants of rheostats, inductance coils and condensers in an exceedingly simple and easy manner.

L. W. Curtis has developed a very simple hookup for a one-tube super-regenerative set. For the experienced operator it should prove just the thing for use with a loop in an automobile. How he does it will be told in July RADIO.

Carlos S. Mundt, in an article on "Easily Made Capacities," presents a simple means for figuring condenser sizes. His graphical method takes the place of some rather formidable mathematics in condenser design and gives practical results.

Samuel G. McMeen describes "An Adjustably Sensitive Receiver" which for simplicity of construction and accuracy of tuning is a wonder. It is especially remarkable in its ability to exclude what is not wanted.

Because of the consistently good results that readers have secured in following constructional directions by D. B. McGown, U. S. radio inspector in the Sixth District, special interest attaches to his next article on "A Peanut Tube Single Circuit Set." It combines a tuner, detector and one-stage of amplification in a portable set.

The fiction feature will be the story of "Jimson the Great" by Earl Ennis, one of the funniest yarns yet published in these columns. A couple of ex-cowpunchers quell a South-American revolution via radio. It has at least a chuckle a minute.

L. R. Felder has another of his excellent radio articles expressed in ideas of one syllable. This time he discusses the why of high resistance and high frequency. After reading it any reader can answer the question intelligently.

W. G. Gross describes how to construct a 75-ft. wooden antenna tower which is rigid, strong, light and easy to erect. It can be built by anyone who can measure and use a hammer and a saw.


"He who lightly promises,
is sure to keep but little
faith"-Lao Tzu
Wink knowingly
at him who would sell you
something "just as good" as a
Grebe Receiver
Doctor Mu.
A. H. GREBE & CO., Inc.
Richmond Hill, N. Y.
Western Branch
451 East 3rd Street, Los Angeles, Cal.
GREBE RADIO
Musings of Doctor Mu
Write for
"Musings of
Dr. Mu."
Licensed under Armstrong
U. S. Pat. No. 1113149

IDEAL RADIO SET FOR YOUR VACATION

Victory-Grantone

Victory-Grantone

Radio Receiver No. 550

AMPLIFIER and LOUD SPEAKER

This unit has no equal in the entire radio industry.

Enables everybody now to fully enjoy radio entertainment without nuisance of taking turns with head receivers. Operates with equally remarkable efficiency from the simplest kind of crystal set to the most elaborate vacuum tube detector.

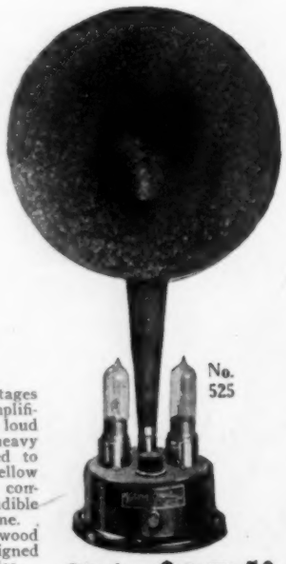
Contains besides two stages of audio frequency amplification a super-sensitive loud speaking element with heavy mica diaphragm adjusted to give a true natural mellow tone, which can be controlled from a soft, audible sound to a mighty volume.

Horn is of durable wood fibre composition designed on best acoustic principles.

A Victory Selector Jack with automatic filament control gives one or two stages of amplification.

No. 525 operates with two dry cells, using 1½ V. tubes.

No. 535 operates with storage battery, using standard 6 V. tubes.



No. 525

Price of either unit without tubes **$37.50**

Wherever You Go Radio Follows

It's everywhere. And now, with Victory-Grantone No. 550 Loud Speaking Radio Receiver, you will be able to enjoy broadcast concerts, lectures, sermons, and keep contact with daily events of the world while you are away on your vacation. No need of being isolated from the outside world, when you can so easily tap the surging electro-magnetic waves that permeate every nook and corner of the country, from seashore to mountain fastness.

Portability is one of the outstanding features of Victory-Grantone Loud Speaking Radio Receivers. It's an ideal outfit to take along on trips, motoring, and vacations. Even when going to parties or entertainments this set can be conveniently carried and always depended upon. Its receiving range, according to reports from enthusiastic owners, covers the entire continent. And on the Loud Speaker too.

This is truly the most compact, neatest and totally self-contained loud speaking radio receiver yet developed. Embodies everything necessary for its operation. No unsightly loose batteries, wires, parts, etc., but everything is in a complete unit which may be readily carried from place to place and ready for instant operation.

The detector and tuning unit is simple, sharp, very selective and extremely sensitive. It is encased in a housing which shields it from all body capacity and other external influences, thereby giving maximum receiving efficiency.

The Amplifying Loud Speaker contains besides two stages of audio frequency amplification a super-sensitive loud speaking element with heavy mica diaphragm adjusted to give a true natural tone, which can be controlled from a soft audible sound to a mighty volume. A Victory Selector Jack with automatic filament control gives one or two stages of amplification. Complete weight only 22 lbs.

Operates only on two dry cells without storage battery.

Price without Tubes and Batteries.....$65.00

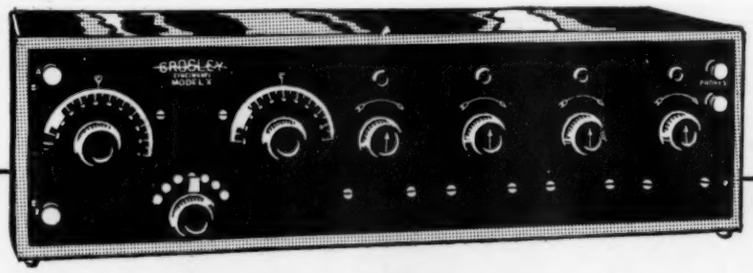
Price complete with three 1½ Volt Tubes, two 43 V B Batteries and two dry cells.....$95.00

Send for FREE descriptive catalog of Victory-Grantone Products

Dealers: Don't miss this summer business. Wire or write for trade proposition

VICTORY RADIO-ELECTRO CO.

559-561 HOWARD ST. SAN FRANCISCO



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Uses FORMICA for Panels and Insulation

CROSLEY radio sets are universally known and used. They are produced in a factory that is famous for its well developed production methods and factory systems.

Radio engineers for the Crosley Manufacturing Company, like those of nearly every other well known independent radio manufacturer, appreciate the superior qualities of Formica insulation for radio.

They use it in panels and for many other purposes in connection with their radio product, because it is good looking, because it works well with ordinary tools, and because it has high di-electric strength and maintains it indefinitely, improving with age.

The Crosley Company is a large distributor of Formica panels and of radio parts of its manufacture in which Formica is used for insulation purposes.

Formica dealers can supply you promptly with panels in all standard sizes. They can also supply special sizes when you want them.

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FORMICA
Made from Anhydrous Redmanol Resins
SHEETS TUBES RODS

The City's Music In Vacation Times

Thousands of summer resorts are going to keep in touch with the world by radio. Thousands more will wish that they had thought of it.

The Jones *Symphony* Receiver, detector and three stage, is particularly fitted for this service.

Because: **FIRST, it is positively in a class by itself in the durability of its construction and assembly.**

SECOND, its simplicity of operation.

THIRD, its reliability.

We sell with the Jones *Symphony* Receiver, for this purpose, a stout traveling case. All you need to do is to disconnect your leads, put the *Symphony* in the case, turn the lock, put the case in your car with a couple of "B" batteries and you are all fixed. Use your automobile battery. If that isn't convenient, use "peanut tubes" with adapters. If you want the best, we suggest using regular tubes with a six volt battery. You can rent one at any town.

But in any case include a Jones Receiver in your summer outing plans. The *Symphony* will repay you many, many times over.

The use of the *Symphony* under many and varied conditions proves it to be one of the most efficient long distance receivers on the market. Every part of the *Symphony* is built and inspected by the Kellogg Switchboard & Supply Company, for twenty-five years manufacturers of highest grade telephone equipment.

Ask your dealer —If he has not a *Symphony* in stock, or complete information, wire us immediately. Get your order in at once to avoid delay.

JONES RADIO COMPANY

LYTTON BUILDING, CHICAGO

The Symphony is manufactured under U. S. Patent No. 1113149, Armstrong Regenerative Circuit

You don't have to wait—

YOU need a radio panel and you want it immediately. But you go to a dealer expecting a delay while your panel is being cut.

He, however, turns to his shelf and hands you a Condensite Celoron Radio Panel, cut and ready to carry home. All this is in a few seconds from the time you enter the store.

This isn't fiction. You can now get Celoron Radio Panels cut in standard sizes. No longer will you have to wait and pay the extra cost for having your panel cut from sheet stock.

Each panel is a separate package, cut, trimmed, and wrapped in glassine paper to protect the surface. On every one are full instructions for working and finishing.

You can obtain from your dealer any of the following sizes:

1. — 6 x 7 x 1/8	5. — 9 x 14 x 3/16
2. — 7 x 9 x 1/8	6. — 7 x 21 x 3/16
3. — 7 x 12 x 1/8	7. —12 x 14 x 3/16
4. — 7 x 18 x 3/16	*8. — 7 x 46 x 3/16

**This strip for cutting special sizes. Not wrapped in glassine.*

While we feature these standard sizes, Celoron comes in full-size sheets and we can supply special sizes if desired.

Condensite Celoron has long been used in connection with electrical and radio work because of its high insulating qualities, high dielectric strength, and low dielectric losses. It is easily worked, machined, drilled and tapped, and will engrave evenly without feathering. It is a laminated phenolic condensation product used by many of the leading manufacturers of radio equipment.

Select the size you need for your set. Should your radio dealer not yet have them in stock, ask him to order for you. Or write direct to us designating by number the size you need.

Send for free booklet

We have prepared an attractive booklet, "Tuning in on a New World," which tells more about Celoron and gives lists of leading broadcasting stations in the United States and Canada, symbols used in reading radio diagrams, and several highly efficient radio hook-ups. This booklet will be of use to every radio fan and will be sent to you free of charge upon your request. Write today.

To radio dealers: Write for special dealer price list showing standard assortments

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CONDENSITE CELORON
STANDARD RADIO PANEL

Transformer
UV-712
$6.50

Volume—undistorted!

With Audio-Frequency Transformer UV-712

—Complete shielding to prevent interaction between fields.

—Sturdy build to withstand rough use and much handling.

—Exact construction to eliminate distortion in each stage of amplification.

—Special care to minimize transformer losses, which gives unequalled volume.

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This symbol of quality is your protection.

Particularly Designed for Use with RCA Radiotrons

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MAY 28 1923 ©CIB577804

June 1923 | RADIO | Vol. 5, No. 6

Established 1917

Radiotorial Comment

"WIRED wireless," or line radio, is being successfully used by electric power companies over their lines which already supply light and power. The Pacific Gas and Electric Company of California is regularly using it for communication over its high tension lines with no radiated interference with outside receiving sets.

The successful operation of this installation is raising hopes that line radio offers a practical means for collecting revenue from broadcast listeners and thus financing the heavy cost of operating a station. While this is in a measure true it will not prevent the enterprising American boy from getting the messages off the wires as easily as out of the air.

While the low-frequency current used for power and light supply cannot be taken in quantity without physically tapping the wire, radio frequency current is not to be so confined. Although it follows the guidance of the wires, its field so fills the surrounding space that enough current to operate a receiver may easily be taken off by induction. So another money-maker goes a-glimmering.

"WHAT is so rare as a day in June," or July either for that matter, if you have a radio set along for your vacation trip? This summer, radio will take its rightful place as an outdoor sport. With baseball scores, dance music, news, and entertainment of all kinds on the air there need be no monotony in the most remote camp.

Whether journeying by train, auto or boat, whether sojourning in the high mountains or by the seashore, a portable set with a loop aerial will bring in the broadcasting. The past year has witnessed the development of stations so powerful that there is no corner of these United States that is not reached by radio today. Furthermore, with the new dry battery receiving sets a radio outfit is as portable as a camera.

Receiving conditions are far better this year than last. The greater radiation of the broadcast stations, as compared to the feeble output of most stations last year, is more than sufficient to drown out vagrant atmospheric disturbances. The loop aerial is a partial static eliminator in those parts of the country where this is found. In this connection it is of interest to note that little or no static is heard on the Pacific Coast.

Something of the "how" of a radio vacation is told in two articles in this issue. One gives some valuable hints for the use of radio on inland waters and the other tells of the trials and tribulations of a too-popular radio traveler.

The ham as well as the B. C. L. can get pleasure with radio in the great out-of-doors during the hot summer afternoons and evenings. A double interest attaches to the "card" sent to the amateur transmitter at home from his vacationing fellow amateur. Success in surmounting difficult conditions is a test of your receiving ability. Some of the best operators of this day and generation served their time in the tropics and there gained their "ear" and exercised their ingenuity in devising ways and means for reducing static. There is as great a fascination in doing this as in getting winter D. X. records.

So, to re-iterate, make this a radio summer.

'TIS with regret that we are unable to publish many excellent letters to the editor, for the simple reasons that the writers do not sign their names. While a *nom de plume* is permissible when published, yet the original letter should contain the correct name and address of the writer. This is necessary because the responsibility for statements made rests upon the author and not on the editor. No such responsibility can be placed in the case of an anonymous letter. With this understanding, letters of comment and criticism are always welcome and will be published when space permits.

WHEN the order comes to dismantle spark sets, as come it will, no one can complain that they did not have due and sufficient warning. The latest forecast of the impending storm is the recommendation of the Second Radio Conference "that spark transmitting apparatus be replaced as rapidly as practicable by apparatus which will produce a minimum of interference." This means C. W. eventually.

That slogan made famous by national advertising, "if eventually, why not now?" has a special application in this case. Just as the volunteer gains more credit and a greater personal satisfaction than the drafted man, so likewise does the transmitting amateur who installs C. W. before he has to. The recommendations are not yet compulsory but soon will be.

The many advantages of a tube set over a spark set for handling traffic have been stated so often in these columns as to make their repetition unnecessary now. Those of a purely selfish character are more than sufficient to justify the changeover without reference to those involving a consideration of the privileges of others. And as interference with the privileges of the broadcast listeners threatens a curtailment of amateur transmitting privileges, it is greatly to the self-interest of the amateur fraternity to immediately eliminate the spark.

With these considerations in mind, we consider the several articles in this issue on how to change over a spark to a tube set and on how to make simple C. W. outfits to be especially timely and useful. Never before within the covers of one periodical has there been published so much helpful information for the transmitting amateur. We hope that the space is not wasted.

The Sinking of the Radio-Controlled U. S. S. Iowa

By Jennings Dow, Lieut. (jg) U. S. N.

With an opening and concluding paragraph by Captain C. H. Dickins, U. S. N.

An eye witness tells of the dramatic use of radio in controlling the movements of this fore-doomed ship. This demonstration of the destructive power of the modern high power guns was made possible without danger to human life solely by means of radio.

IN a fight in which there could be but one outcome, the old battleship *Iowa,* went down to a watery grave at 4:17 p. m., March 22, 1923, with her colors flying proudly to the breeze, while a great, modern battleship, the latest creation in the United States Navy, the *Maryland,* fired a salute of 21 guns in her honor, after she had sustained a gruelling punishment for two days!

It would not have seemed so hard, had she been privileged to meet her enemy, and even against great odds to fight a losing battle, but like a giant with manacled feet and hands, under the hypnotic influence of the *Shawmut,* she sailed forth on the sunlit seas of Panama Bay to take the shock of tons of steel entering her vitals. It seemed a thing almost incredible that any ship could have withstood such an onslaught. Even had she had her original battery and her crew of iron men who fought upon her decks during the Spanish war, led by her invincible commander, Captain "Bob" Evans, it would have been futile, for the science of gunnery has moved on to such an extent that the *Mississippi* fired upon her from a range that her guns could not possibly have reached. It was a tragic, yet fascinating end of a brilliant career.

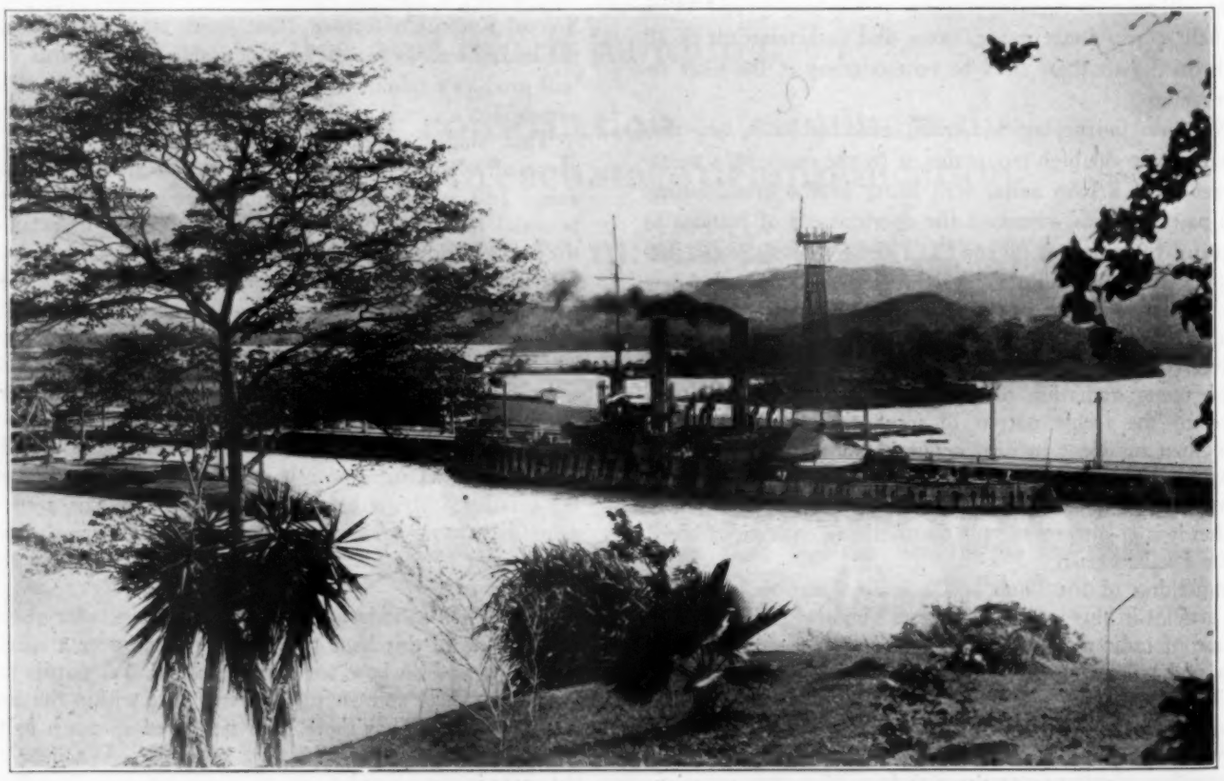
To those who had the good fortune to witness the long range bombardment of this radio-controlled ship off the Republic of Panama during the winter maneuvres of the United States Fleet and to see the grand finale of her twenty-six years of service under the Stars and Stripes, as she stubbornly resisted the warm tropical waters which entered her compartments thru a score of holes made by the unerring gunfire from the fourteen-inch rifles of the modern Mississippi—a long-to-be-remembered, awe-inspiring sight was theirs. To the hundred thousand or more, representing every walk of life today, who have served in the fleet with this grand old ship, or even upon her, there will come many a reminiscence of bygone days. And to the millions who, during the past two years, have been interested, instructed, fascinated, and ultimately charmed by the introduction of radio into our everyday lives, the event should prove of more than passing interest.

The Gunnery Exercises

THE purpose of this practice was not to sink the *Iowa* in the shortest time, but rather to test the accuracy of modern naval ordnance, the control of gunfire, the accuracy of personnel, and to study the effects of gunfire. To this end, a special type of high explosive shell was used. This type of shell differed from the regular service ammunition only in the kind of fuse which was used, and in the weight of the bursting charge which exploded the shell upon impact. In the case of regular service ammunition, the shell explodes after it has had time to penetrate into the armor of the target, and in this manner, great havoc is wrought and serious damage to any target results from the bursting of even a single shell. In the case of the special ammunition used in this practice, the fuses were so adjusted that the explosion of the shell upon impact was instantaneous, which resulted in restricting the damage to the outside of the target.

The *Maryland,* flagship of Admiral H. P. Jones, Commander-in-Chief, U. S. Fleet, the *California,* flagship of Admiral E. W. Eberle, Commander-in-Chief, Battle Fleet, together with the *Arizona, Pennsylvania, Nevada* and *Mississippi* slipped away from the fleet anchorage off quaint old Panama City promptly at eight-thirty on the morning of the twenty-first of March for the first day of the practice, formed column,

Continued on Page 66



U. S. S. "Iowa" Entering Miraflores Lock, February 10, 1923.

Radio's Gift to the Wire Lines

By Samuel G. McMeen

A great future is in store for those who understand the theory and practice of vacuum tubes. Its use as a telephone amplifier is but the first of many non-radio industrial applications. How this is done is here plainly told. The greatest by-product of the radio game is the knowledge gained by the player.

THE addition of the third electrode to the two element tube of Edison was an epochal act. From it came the arts of radio transmission and reception as most widely practiced today, though a radio art of some proportions already existed at that time. The present tendencies indicate that before long the three electrode tube will be the universal element for both transmission-generation and reception.

But the tube so created was not far along in its conquering way when De Forrest, its inventor, discerned that it had other possibilities than those related to radio transmission and reception, and proposed its use as a regenerative unit in telephone lines. Its application to that task was not immediate, but when the application did come about it re-created an entire art along directions only partly mastered theretofore. The influence of the tube on the art of the wire lines for telephony quickly assumed the same order of greatness as its influence on radio development.

What was actually done in this application of radio apparatus to lines was to utilize the amplifying properties of the device in telephone repeaters, whose function is to receive the enfeebled speech of a long distance conversation and recreate it in more robust volume, while still retaining all—or as nearly all as possible—of the original fundamentals and harmonics that made up the speech-current.

There were telephone repeaters before the vacuum tube was adopted for such uses, but they had the serious limitation that they operated by means of mechanical motions, and while the inertia of these parts was reduced to a low amount there was still loss that was out of proportion to the delicacy of the task. What was needed was a moving element that was of atomic order of size. The electron of the tube being many times smaller than even an atom made the solution an ideal one. It has resulted already that speech can be transmitted over distances adequate for all the continents of the earth, and in any volume that may be needed for the task in hand, even to the received speech being made audible and understandable to a vast assembly of people.

The one great element of electrical communication that has not yet been brought under the subjection of the wire-line telephone is the trans-oceanic cable. That problem is yet to be solved, but its difficulties may turn out to be no greater than those of the problems that have already given way to man's earnestness and zeal.

Mr. Thomas D. Lockwood once said that if radio communication had been invented before men knew that wires would guide electricity to a destination, the man who first used a wire would have been hailed as a great genius. Someone else said that the conception of a wire as a useful "hole through the ether" and its adoption as an electrical path were as great mental triumphs as the whole conquest of the ether for the radio waves. It may well seem so. Particularly when the desirabilities of privacy of communication are kept in mind.

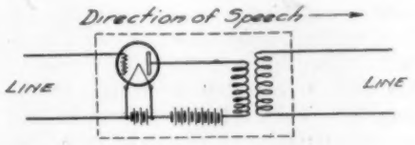


Fig. 1. One-way Repeater.

The use of the vacuum tube as a repeater unit is shown in its elemental form in Fig. 1. Here the tube receives the incoming speech current at its grid and filament, where the voltage variations control the output of current of the plate circuit, exactly as in the operation of any detector, amplifier or transmitting tube in any radio circuit using a tube. The changes in plate-current amplitude are kept local by the insertion of a transformer in the output circuit, and in the secondary side thereof the energy is in the form of alternating current, which passes over the line in amplified volume as compared with the incoming speech current that gave rise to it.

Just as it is possible to use two or more amplifying tubes in tandem in a radio circuit, so it is possible to put a series of repeater elements in a telephone line. A series of this kind may be set up by merely connecting the transformer side of the element of Fig. 1 to the grid side of the next element, through the intervening section of line. The length of that intervening section can be chosen at will, but naturally would be the length in which speech can be transmitted satisfactorily but beyond which length the speech would begin to be too weak to be satisfactory.

But such an arrangement of simple elements has the serious drawback that, excellent as it is, it will transmit in only one direction, from its grids toward its plates, and commercial speech is always conversation and therefore a two-way operation. To encompass this one or the other of two courses must be taken.

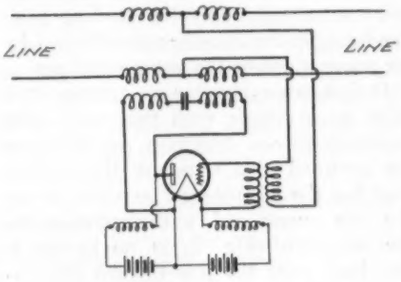


Fig. 2. Two-way Repeater.

One of the courses is indicated in Fig. 2, in which a single tube does the work, as in Fig. 1. But this tube now is related to the line through a special three-winding transformer enabling the tube to talk back into the line after drawing from it a portion of voice current to be amplified. As in the first case the action is to cause voltage changes on the grid to produce in turn current changes in the plate circuit. But in the new case the speech that causes may come *from* either end of the line, and the speech that is caused may proceed likewise *to* either end of the line. There is no commercial need that the amplified speech should go toward the speaking end of the line, and so far as it does so there is loss. But the desired action has been achieved, and amplification has resulted even though there is some loss,

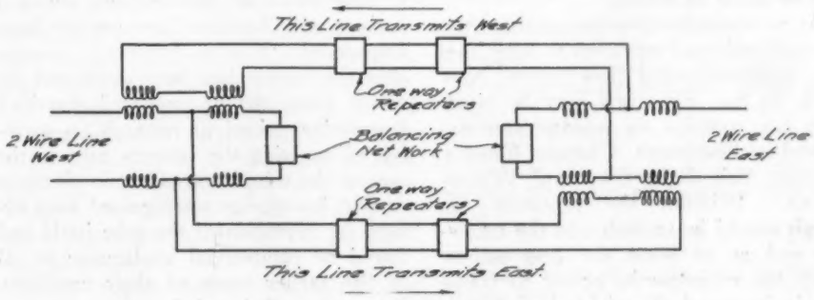


Fig. 3. Four-wire Line with One-way Repeaters.

so that the arrangement is a satisfactory one.

Another method of transmitting through repeaters in both directions is shown in Fig. 3, in which the going and coming paths are separate except at their ends, and in which the line consists of four wires. Each two-wire path contains one-way repeaters, and the transmission directions are as shown in the figure. The elements marked "balancing network" are impedances equal to the line impedance, and are used to prevent reactions that would make the apparatus howl. In some conditions these networks are composed merely of resistances and capacitances, and in others inductance also is included, the latter being introduced when the lines used are equipped with loading coils for the improvement of transmission.

In the four-wire circuit the relations of the windings of the three-coil transformers are such that voice currents from the two-wire part of the line are excluded from the receiving pair and allowed to enter only the sending pair, this being automatically accomplished by the connections of the three windings.

It is further possible to arrange two tubes in a circuit such that each tube transmits in one direction, yet the two are included in a two-wire line. This plan has the advantage that there is not the loss mentioned with reference to the circuit of Fig. 2, as no energy is sent back over the line toward the station that is speaking at a given instant.

Out of all this creative work in the adaptation of the vacuum tube to the uses of the wire lines have come two more important results besides the extension of the communication radius of the ordinary type of lines on open insulators on poles. It now is possible to work long lines through underground cables, which could not be done before the advent of amplifying means. It also is possible to make the long lines of much smaller conductors than before, so that in some degree the additional complication of the amplifying apparatus is offset by a saving in copper. It does not follow that all the long lines may immediately go underground because of the saving in copper, but it does follow that the way is pointed out whereby first the more important and heavier routes may be so treated and later, as the art develops further, the change may be made in others.

As an example of what results from the application of repeaters to long lines the transcontinental line from New York to San Francisco may be cited. This line contains six repeater stations, located at Pittsburgh, Chicago, Omaha, Denver, Salt Lake City and Winnemucca. Without the repeaters the speech would be so feeble at the receiving end as to leave the line useless. With the repeaters its power to transmit is increased threefold, bringing it well within the limits of commercial usefulness.

The lines between Washington and Boston are wholly underground, and are of much smaller wire than when those lines were on open insulators on poles. Repeater stations are located in the larger cities of the route, and the practical result is that those lines speak more than twice as loudly as they would without the use of such apparatus.

In addition to providing the telephonic art with the fundamental element of a truly successful repeater, the vacuum tube has done more still for the wires. By means of tubes, one circuit can be made to carry a number of separate conversations at the same time without interference, this, like the repeater, being the fruition of a long-continued search. The notion of so using a telephone circuit is nearly as old as the art itself, but its accomplishment waited for the finding of means of creating and sorting currents of high frequency. Both these means are now available, the one by using the vacuum tube as a generator and the other by use of the filter designed by G. A. Campbell. The development of the method has been recent, but is already at the stage wherein a dozen persons may hold six conversations at the same time over a single line.

Futhermore, the same tubes and filters and associated devices may be used for telegraphy over wires, to any reasonable degree of multiplexing, and the marvel is still further extended by combining such telegraphy and ordinary telephony on the same circuit. And all of the advances touched upon are working in the direction of a better service for a greater population over increased distances at lower costs. It would be hard to find a more striking example of the influence of a single piece of apparatus on the needs of the public.

But debts are things to be paid as well as incurred, and this case of the debt of the wire lines to the radio art is no exception to that universal though sometimes annoying rule. At least an installment of that debt is in the way of being discharged in the development of long-wave, long range, commercial trans-Atlantic radio telephony without a carrier wave. This newest of radio's accomplishments has already shown its workability, though at this time of writing *two*-way conversations between Europe and America have not yet been announced. It is of interest to observe that the system has been developed directly from the accumulated classified knowledge gained in research on methods of applying the vacuum tube to the uses of the wire lines. Certain elements of that knowledge were gained long before the invention of the tube itself and found no commercial application at all in the earlier years of their readiness. But no knowledge shrinks by passage of time, and the truths developed by Campbell and Hutin and Leblanc and others were just as fully truths at the time of their first wide application as on the day when each first thrilled its finder.

So far as invention has gone up to today, we can talk with a telephone in only two ways—over a wire and through space by undirected radio waves. More and more these two types of telephone transmission are being used in conjunction with each other, and most usefully. The next step forward ought to be by the use of directed radiation. Something of the path we might travel to that end was shown by Hertz in his original classical experimentation. Marconi has latterly re-entered that field of short waves and given new inspiration to such study. In the development of such a method there will be a further utilization of ways and things that are now ready to hand but have not yet been applied to the new usefulness. The art is full of instances of such belated applications.

PROTECTION OF VACUUM TUBE FILAMENTS

The radio fan is apt to experience disappointment when he finds that the high voltage leads from the *B* battery have been accidently connected across the filament posts of his receiver and one or more tubes are burned out. Although the normal life of the average Radiotron filament is considerably more than 1000 hours, it requires but an instant to destroy this delicate filament when excessive voltages are applied to its terminals.

When filaments are shorted across a 20,- 40- or 60-volt battery in new condition, the burn-out requires but a fraction of a second and unless the user happens to be inspecting the tube at the instant of the flash, the damage would not be discovered until the set was used again. It is a very easy matter to protect tube filaments by either of the following means:

(a) Insert a 100 ohm (non-inductive) resistance for each 22-volt block of *B* battery in the circuit next to the positive terminal of the *B* battery. This resistance may be left permanently in the circuit without any effects whatsoever in the normal life of the receiving set.

(b) Probably the most convenient form of resistance is a 25-watt, 110-volt tungsten lamp which will provide sufficient protection for plate voltages up to and including 100 volts. This resistance automatically increases with the current so as to act, in effect, as a protective ballast lamp.

A burned out tube, like a Mazda lamp, can sometimes be restored by tapping. With the tube in its socket and the *A* battery connected a series of taps may cause the two broken filament ends to touch and to be welded together.

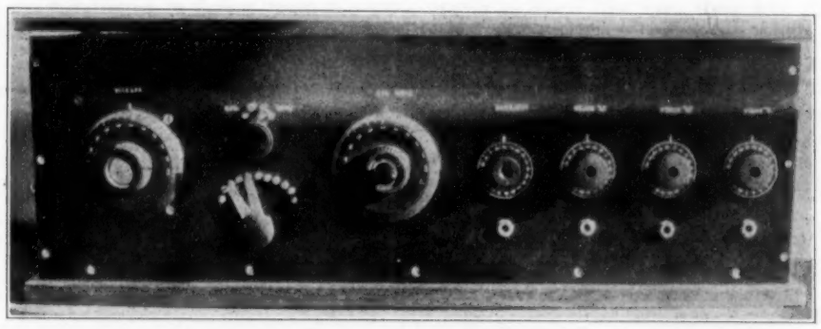
How to Design a Receiving Set

By Florian J. Fox

Most published directions for making a radio receiver assume greater knowledge than is possessed by the novice constructor. This article gives detailed directions for both the design and the construction of a single circuit regenerative tuner with three stages of audio frequency amplification.

IN this article the writer intends to show how the general principles of design are utilized in the construction of a specific set; a regenerative single circuit tuner with three stages of amplification.

First we must formulate our plan. We desire a set that is simple to operate, reliable, sensitive, quite selective, and one that will bring in music on a loud talker from distant points. We may also have a demand occasionally for very loud music. Experience has shown that



Front View of Completed Set

three stages of amplification will answer all of these requirements for volume, and that a good regenerative single circuit tuner combines sensitivity, reliability, and comparative ease of manipulation. As a result we decide to build a single circuit regenerative set with three stages of audio frequency amplification.

Now we must form some idea as to the desired physical appearance. We shall, let us say, decide upon a long single deck affair, because it is easier to wire and inspect in case trouble should develop at some future time.

The next thing to think about is the band of wavelengths that it is desired the set should respond to. It was desired that this particular set should receive amateur stations as well as broadcasting and commercial stations. Further, it was desired that it should respond to about 900 meters maximum in order to include NAA (710 meters) and any other stations that might operate thereabouts at some future time when the lower wavelengths become overcrowded. In any event, the builder should decide for himself just what wavelengths he is interested in and design accordingly for maximum efficiency. If he is interested in the band between 180 and 900 meters he will do well to copy the set described below.

With these facts in mind we are now in a position to choose a suitable tuner. There are three possibilities; a remodeled variometer and external loading inductance; a homemade tuner; or a manufactured tuner such as a variocoupler. Full details for making a tuner are given at the end of this article.

The easiest way is to buy a good variocoupler that has about the right amount of wire for the purpose in mind. There are now a number of good makes available. Choose one in which the rotor is well inside the stator, that is, one that has stator windings on each side of the rotor. Also try to get one the rotor of which has at least 25 turns and not more than 40 turns.

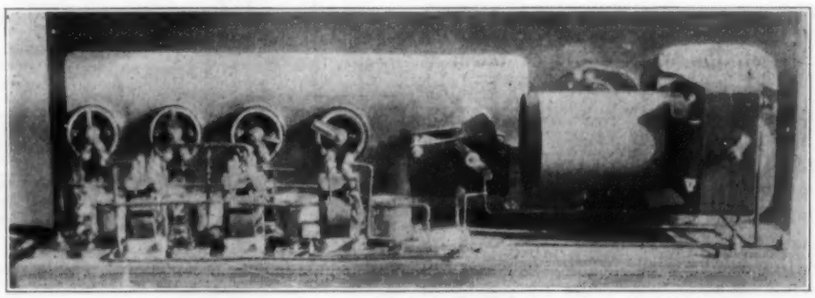
Let us now pass to the selection of a variable condenser. It has been found by experience that for broadcast reception the 23 plate size is about the best. For amateur reception even a smaller one is recommended. Although the 43 plate size works just as well theoretically, practically it is too hard to tune with it. If possible get one with a vernier, the difference in price being more than made up for by the increased ease in tuning.

Four sockets and four rheostats are required. The writer always uses a separate rheostat for each tube. Tubes vary, especially if they are of different makes. In order to get the maximum efficiency out of an amplifier it is necessary that each tube have separate filament control.

For the detector it is strongly recommended that either a vernier rheostat be used or else a Bradleystat. The latter, though more expensive is usually more reliable in the long run. A Klosner vernier rheostat was used on this set. Very few people are aware of the improved results obtained by using a fine filament control on a "soft" tube. Often the amplitude of a signal can be doubled by a very slight increase in filament current. The difference in price is well worth the difference in results.

The following is a list of some of the other items that are required and about the selection of which nothnig need be written:

1 standard grid leak and condenser, 1 megohm, .00025 mfd.
1 phone or "by pass" condenser .002 mfd.
3 good 5 spring jacks.
1 good 3 spring jack.
1 plug.
Several inches brass stock for brackets, ¾"x⅛".
6/32 flat head and round head screws (brass) (those appearing on the panel may be nickeled.)
6/32 brass hex nuts.
Wood screws, etc., etc.
2 brass or aluminum sheets for shields 4"x5" (any reasonable thickness.)
2 4"-dials to fit on tuner and condenser shafts.



Rear View of Completed Set

11 nickel plated switch points.
4 nickel plated switch stops.
1 single bladed switch (1⅛" arm.)
1 double bladed dead-end switch (1¾" arm.)
7 binding posts.
Complete set of name plates if desired (tickler, loading inductance, series condenser, detector, first stage, second stage, third stage, etc.)
Dials for each rheostat may also be procured if desired.
Several yards of No. 14 *hard drawn* bare copper wire.
About 12 lengths of varnished cambric tubing or "spaghetti."

Panel and cabinet wood—materials and sizes taken up later. These to be purchased last.

Wire for coils, fibre or formica tubing, etc.

As will be seen from the diagram of connections, the small two-way switch enables the operator to use either one half, or all of his variometer at will. It has been found that by chance an antenna may be of such a size that one-half of the variometer is not enough for a particular wavelength, and that the whole of the stator is too much. In such a case this switch permits the loading of one-half of the stator. For small antennæ this switch is not necessary, but nevertheless it is a refinement that may be found useful.

The reader may have wondered why the writer has not specified the size of the panel. Some enthusiasts often make the error of buying the panel first. This is bad practice and is excusable only when a set *must* be made of a certain predetermined size. The logical way is to get the instruments first, then lay them out on a table in the order and arrangement desired, and then take the necessary measurements for the size of the panel required.

Several rough sketches are made now and the general layout of the panel determined. Let us assume that we arrive at the general arrangement shown in Fig. 1. We then take some cross section paper and draw two parallel lines to represent the top and bottom edges of the panel. In this particular case these were drawn 8½ cm apart to represent 8½ inches.

The proper scale will of course depend on the rulings of the paper. A line is then drawn to represent the left edge of the panel. Then the various instruments are measured and laid off to scale in a neat and symmetrical arrangement and then the right edge of the panel is drawn in. Care must be taken to allow plenty of room at either end for clearance and for securing to the cabinet. Thus we determine very accurately the size of panel required and at the same time we have made a plan of the panel layout. Some builders may prefer to make a life sized paper template for drilling the holes, while others may prefer to locate the holes by means of marks on the reverse side of the panel. The holes for mounting the tuner and condenser may be drilled last if desired; as sometimes better fits can be obtained if the holes are located from the instrument rather than by measurements.

Any good panel material may be used —a ¼-in. hard rubber panel 28 in. x 8½ in. was used on this set. The choice of the material is best left to the individual taste.

As will have been noted, no holes are drilled in the panel for observing the tubes. Such holes take up a lot of valuable space and are of no practical value. It is with the aid of one's ears and not eyes, that one adjusts the tubes. By simply raising the cover of the cabinet one can determine just as easily whether all tubes are burning if the set fails to function. Further, as in this case, the locating of tubes behind such peep holes, may often cause poor interior design, bad appearance and undue crowding. If a person feels that he must see the tubes burning while using the set, he can affix a narrow mirror, or polished metal plate on the inside of his cover in such a way, that when it is open he can see the tubes by reflection.

Although it may not be considered good practice, we have delayed the choice of our transformers, because we did not know how much room there would be available for them. Our excuse is that we wanted the set to have a nice appearance, and hence it must not be too deep. After considerable thought we decide that a set 9½ in. total depth answers all requirements. That is, the set will look well, and will leave us plenty of elbow room on the table. This latter is quite important if the operator wants to be comfortable when listening-in several hours at a stretch.

Now we must proceed to find out how best to lay out the interior, and how much room we have for our transformers.

The best way is to draw to scale on cross section paper the sub-base and a top view of the panel. The sub-base is to be 26¾ in. x 7½ in. (taking into account such items as a ½-in. margin around base and thickness of walls (½ in. etc). Now sketch to scale the parts that go on the panel in order to secure the required clearance. Then locate the sockets as systematically as possible, and finally indicate by means of squares the positions of the transformers. See Fig. 2. We thus find that our transformers may take up at least four square inches of space. This means we will have to chose a transformer that is mounted in a vertical position.

The writer has had an opportunity to try out many makes of amplifying transformers and at that time the following

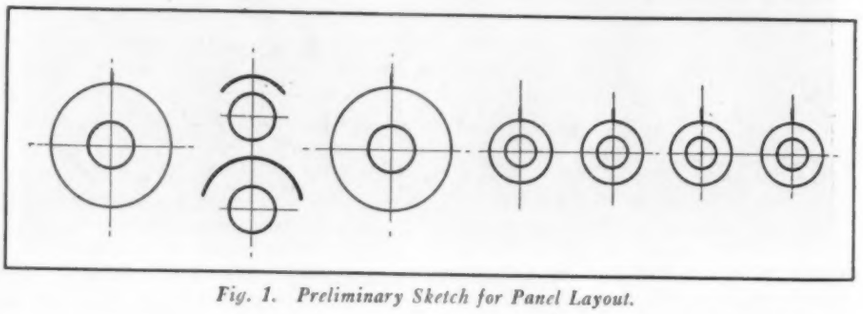


Fig. 1. Preliminary Sketch for Panel Layout.

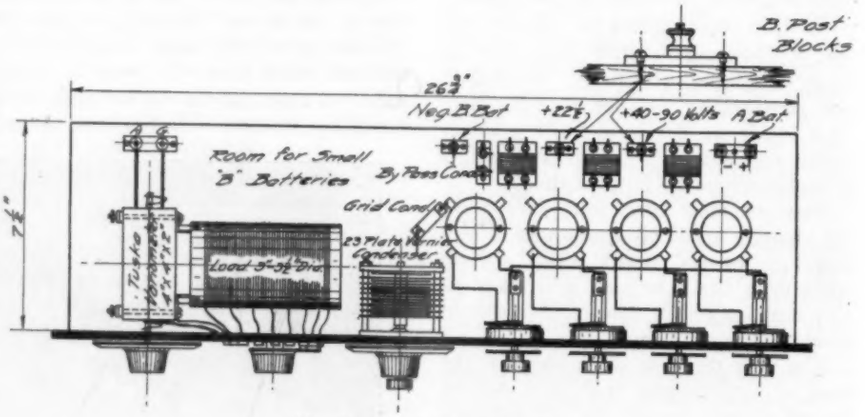


Fig. 2. Final Panel Layout.

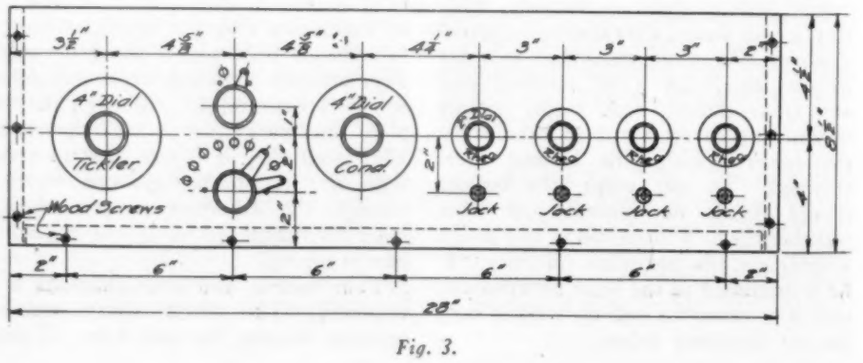


Fig. 3.

were considered to be the best: Federal, Jefferson, Radio Corporation, General Radio, Amrad, Amertran and Thordarson. There have since been placed on the market many other good ones and perhaps many poor ones, but the writer is not in a position to be able to enumerate these and their merits or faults. The Federal was selected because it was the smallest.

It might be instructive here to make some observations on amplifying transformers. Numerous interesting articles have been written on how to make such transformers but from experience we find that, although they work after a fashion, they are usually scientifically incorrect. For that matter there are quite a number on the market that are no better. In any event, when the time and money spent in making them and the results obtained are considered, we can safely say that it is much better to buy some good ones at the start. The average experimenter with the materials he has available can not hope to duplicate the work of skilled engineers with large research facilities. It must be remembered that voice frequencies, unlike spark frequencies, vary over wide ranges in short spaces of time, hence it is quite a problem to design a transformer that will respond equally well to all frequencies within the limits used. If it does not, certain frequencies will predominate or be louder, and the result is distortion. That is to say, technically speaking, such transformers do not have a "straight line" characteristic. It is easy to see that when several stages of amplification are used, tremendous distortion may result. Sometimes three transformers (different makes) may be combined in such a way that the distortion is not noticeable, but without laboratory equipment this may be quite a task. The obvious thing to do, then, is to select a good transformer, one that has a "straight line" characteristic over the voice and music frequencies. There are several such transformers now available.

Other important factors are the ratio of turns, quality of the iron, and the resistances and impedances of the windings, and so on. A technical discussion of these various features is beyond the scope of this paper. Suffice it to say that most reputable transformers have been designed to operate efficiently with the standard tubes available. For those interested in the theory of amplification it is recommended that they read the excellent articles by Mr. Louis Frank in the Nov., 1922, issue of RADIO; i. e. Theory and Design of Amplifiers.

Let us now return to the subject at hand. The following are the last purchases required:

3 transformers.
Cabinet wood, oak was used.
Sizes—
1 base 29"x9½"x¾"
I top 29"x9½"x½"
2 ends 7¾"x8½"x½" each
1 back 28"x8½"x½"
Sub-base—any suitable wood.
Size 26¾"x7½"x¾"
Stain (flemished oak use). Varnish or shellac and linseed oil.
Hinges, etc.

The cabinet was first stained and then finished with linseed oil and shellac, hand rubbed to desired finish. Good varnish well applied also gives a nice finish, but the writer preferred a dull finish rather than a shiny one.

It might be well to make two shields as shown in Fig. 5a and 5b, one for the tuner and another for the condenser. These may be made of brass, aluminum, copper, or zinc. Laquered brass was used in this set. It may be noticed in the pictures that a large shield was used to shield both the condenser and the rheostats, but since the rheostats are essentially at ground potential, these do not have to be shielded. The shields are

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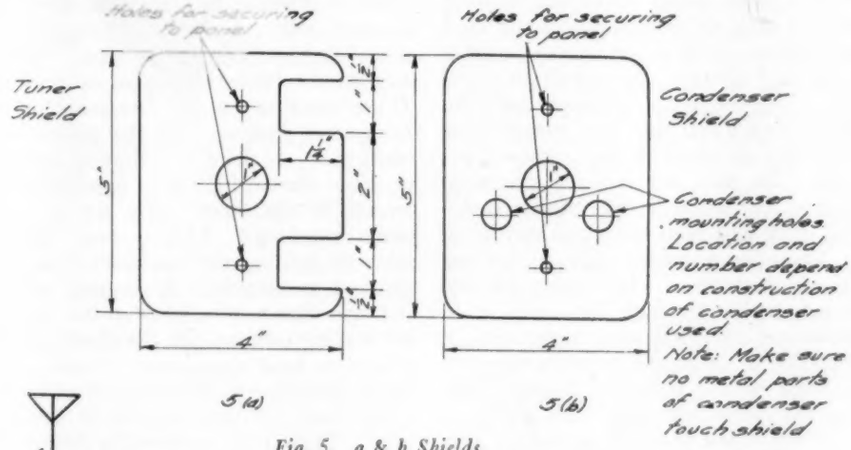

Fig. 5. a & b Shields.

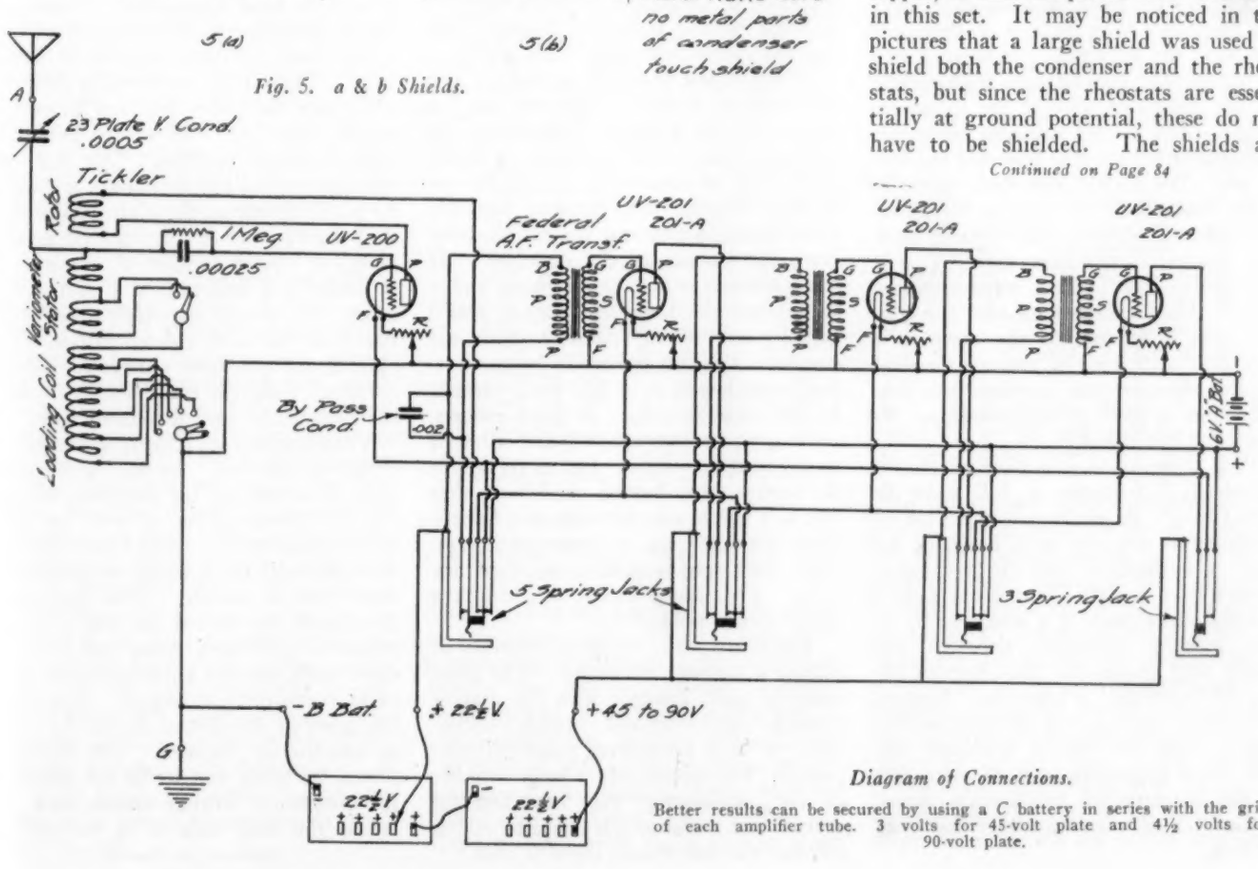

Diagram of Connections.

Better results can be secured by using a *C* battery in series with the grid of each amplifier tube. 3 volts for 45-volt plate and 4½ volts for 90-volt plate.

How to Buy Radio Apparatus

By Raymond F. Yates, I. R. E., Member of Radio Club of America and American Physical Society

The "caveat emptor" of the ancient Romans is but too true today in the radio market. Of what to beware is here told. To observe these helpful hints is to avoid disappointment in the purchase of radio parts.

IF we could buy radio apparatus with the intelligent discrimination that our wives exercise in purchasing vegetables or a choice cut of meat we would have less trouble and many of our radio ills would disappear. Our condenser would "condense" better, our 'phones would "'phone" better and our rheostat would "stat." It is obvious that as yet we cannot buy our radio products like we buy our shaving cream or hair tonic. The majority of hair tonic and shaving cream manufacturers are honest and they know their business. We have honest manufacturers in radio to be sure, and some are honest but do not know how to make good apparatus. Some are honest and know how to make good apparatus too.

These are cold facts and consequently it is important that we know the good and bad points of design when buying instruments at the radio shops. True, we can only subject them to optical test, but even that is important.

Take the ordinary rheostat for instance. Good rheostats embody refinements of design that make for long life and efficiency. The first thing to look to is the sliding contact. Is the end pinched up in a manner which will allow it to slide freely and smoothly over the resistance wire in a way that will not wear the wire out? Is there a stop to prevent the contact arm from sliding off the resistance wire at the minimum point? The writer has seen numerous rheostats in which this was entirely forgotten. We should also look carefully to see how tightly the wire is wound on the strip. If we can move it easily with our fingers that means that we will eventually have some short-circuited turns. Then we must see that the contact arm is secured to the shaft in a way that will keep it there. General good appearance must be taken into consideration as well as workmanship. So much for the rheostat.

Will those of us who have purchased half-dead *B* batteries at full price be wise enough to ask to see the date of manufacture on the next batteries we buy? *B* batteries of even the best manufacture have a shelf-life of from 4 to 6 months. In general it is also wise to refuse bulging batteries, although the dealer may insist that this battery illness of "gastritis" is harmless. Experience shows that a real healthy battery with a long life before it should not show these symptoms. Let us not forget to buy batteries of well-known manufacture. This is one insurance that costs nothing.

Who would think that it required any discretion to buy a vacuum tube socket? Yet here is a device to which is attached great importance. It is also a device that has caused no end of trouble to the uninitiated. We may place a tube in a socket, place the socket in the circuit and find that it works, but this does not mean that it is a good socket. Our outfit might be better if we had a different socket. First and foremost, does the socket have wiping contacts or contacts that will insure perfect connection? If it is a moulded socket, is it moulded of good insulating material? If it is moulded of "mud" with a large dosage of carbon coloring matter in it we cannot expect any kind of efficiency with it if it is used in radio frequency circuits. It is well to pluck the spring contacts a few times with the fingers so see that they have enough snap and vigor to return to their normal position. If they are not of phosphor bronze, but of some soft inferior material, they will bend easily and stay bent.

There is a golden rule in buying storage batteries. The storage battery is a veritable cat in a bag unless it is purchased from a manufacturer with a reputation. In buying batteries then, let us stick to the policy of buying from manufacturers who have made good.

Seeing is not believing in radio. We can look at a fixed condenser but we cannot see its actions. Laboratory observations have told us what to avoid in the way of makeshifts. In audio frequency circuits the currents actually have a tendency to tear the tinfoil away from the surface of the dielectric. If the condenser is not sturdily built and is loosely assembled, the materials in it will actually vibrate in sympathy with the current. We can prove this by connecting a condenser to a 500 cycle circuit. It will hum merrily. A fixed condenser should be impregnated and allowed to dry under pressure. Let us refrain in the future from buying condensers that feel soft and mushy between our fingers. They are inefficient, current-eating monsters with an insatiable appetite for juice. They spend energy as a drunken sailor spends money.

There are many things to consider in buying a variable condenser. The great rush in radio brought into the market variable condensers and variable condensers. 95% of them were practically impossible, but fortunately a large number of the unsatisfactory type have left the market and if this article could be 100% efficient the rest would leave as well.

Although it may seem odd, the first thing the writer always look at in purchasing a variable condenser is the edge of the plates. If the delicate rubbing of the fingers over the edge detects burrs it is a safe bet that the manufacturer was a careless one. Although the burrs left by the cutting dies should be removed, many losses can be traced to them. Does the condenser have brass bearings for the shaft? This is important since it adds to long life. Are the moving plates properly insulated from the stationary plates? Fibre does not measure up to the standards of high dielectrics in insulating strength. It is a moisture absorbing substance treacherously inefficient for this purpose. Bakelite, formica or some other good insulating compound should be used for this purpose. Then too, do the plates turn hard or easily? If we wish to use the condenser in a horizontal position will the plates remain put? Is there an adjusting spring or screw that will allow us to adjust the tension of the shaft? Are any of the plates touching? This we can determine by holding the condenser close to ear and turning it. A scraping noise indicates that two or more of the plates are making contact. Are the plates made of soft or hard aluminum? Good condenser plates are made of hard aluminum which has a certain amount of spring in it. Then if we accidentally drop the condenser the plates will not be permanently bent, but will spring back into their original position. We can tell whether or not the aluminum is springy by plucking one of the plates and noting its behavior. If it vibrates and gives a clear-cut ring it is hard aluminum. If it produces a dull note it is soft aluminum. We should also look to see if the plates are cut with a sharp corner. The careful manufacturer always rounds the corners. Save for the shaft, no iron or steel should be used in a condenser.

Variocouplers and variometers can be classified together. In buying such devices it is well to lay emphasis on mechanical construction as well as electrical construction, since these devices are inherently weak owing to the general form that is adopted. The Bureau of Standards has shown us that properly prepared cardboard tubes are not bad electrically, but we know that they have little mechanical strength. Therefore the tubes in this device should be made of bakelite or formica. The bearings should be brass, and let us not overlook the matter of flexible connections between the two coils of a variometer.

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Converting a Receiver Into a C. W. Transmitter

By Jerome Snyder

This article is for the beginner who has so perfected himself in the code and theory of radio that he has secured his license and is ready to build a transmitter. Before making a more elaborate and powerful set, he will learn much by changing over his receiver as herein suggested.

A VACUUM tube regenerative receiver can be converted into a C. W. transmitter by the addition of a telegraph key and a slight change in the hook-up. Or likewise it can be changed into a radiophone transmitter by the addition of a firstclass microphone.

The regenerative receiver has the property of amplifying incoming signals by means of the regenerative control, whether it is the tickler in the plate circuit of the receiver, or the variometer in the plate circuit. As the coupling of the plate tickler is increased or the inductance of the variometer increased, the

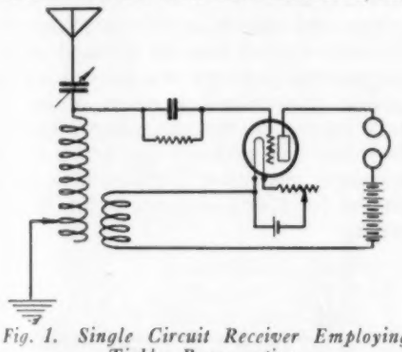


Fig. 1. Single Circuit Receiver Employing Tickler Regeneration.
This circuit should show ground connection for the filament.

beginner has observed that his signals increased in intensity. However, he will also have observed that if he increased the coupling of the tickler or the inductance of the variometer too much the signals became mushy and the speech distorted. This is due to the fact that he has converted his regenerative receiver into a miniature transmitter, and the wave coming from his receiver-transmitter interfere with the received signals and distort them.

A regenerative receiver is made into a transmitter by increasing the tickler coupling or inductance of the plate variometer to the point where received signals are interfered with and not clear. In March RADIO the writer pointed out that one chief source of interference in broadcast reception was due to the oscillations being sent out from regenerative receivers which were not operated properly. When the receiving set is thrown into this oscillating condition, if a small milliammeter is inserted in the ground lead of the antenna a deflection of the needle will be noted. This is due to the small oscillating current from the receiver transmitter. Thus by simply increasing the feed-back coupling of the tickler or the plate variometer we can have a small transmitter at practically no cost.

In Fig. 1 we have a single circuit receiver employing tickler regeneration.

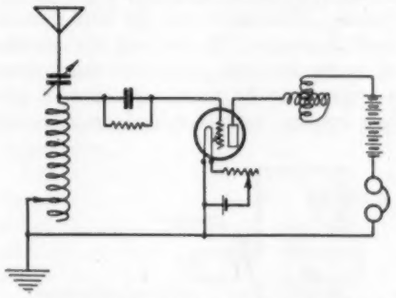


Fig. 2. Single Circuit Receiver Employing Plate Variometer Regeneration.

In Fig. 2 we have a single circuit receiver employing plate variometer regeneration. When the set is used for transmission it is not necessary to have the telephones in the plate circuit, especially if the beginner has a small milliammeter which he can place in the antenna circuit ground lead. This milliammeter should be a radio frequency ammeter. When the needle is deflected it shows that oscillations are being transmitted by the antenna.

However, if the beginner has not this instrument he may use the telephones to ascertain when his set is generating oscillations for transmission. The method is as follows: Begin with the tickler coupling or the plate variometer at zero. Gradually increase either until a dull thump or click is heard in the head tele-

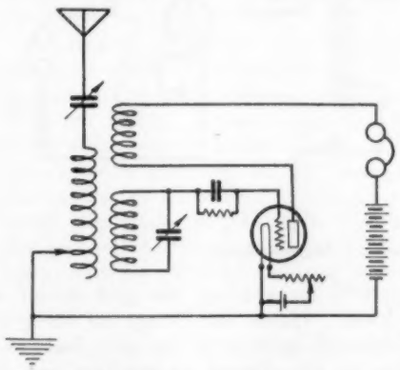


Fig. 3. Two Circuit Receiver Employing Tickler Regeneration.

phones. The set has begun to oscillate at this point and is now radiating or transmitting oscillations. By increasing further the tickler coupling or plate variometer an increase in the strength of these oscillations may be secured, but this increase will not be detected by the telephones. An ammeter is required for this. The telephones, then, simply indicate to what point the tickler or plate variometer must be moved to secure oscillations from the set. If the beginner has a two circuit tuner as in Fig. 3 and 4 the method of securing oscillations is the same as that described for the single circuit tuners.

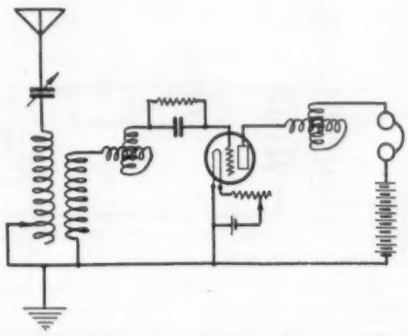


Fig. 4. Two Circuit Receiver Employing Plate Variometer Regeneration.

Having now secured oscillations in the antenna circuit let us see how we can use these for telegraphing or telephoning. Telegraphy requires the use of a sending key to send the dots and dashes of code, and telephony requires the use of the microphone to modulate the outgoing waves. These instruments may be placed in any one of a number of ways.

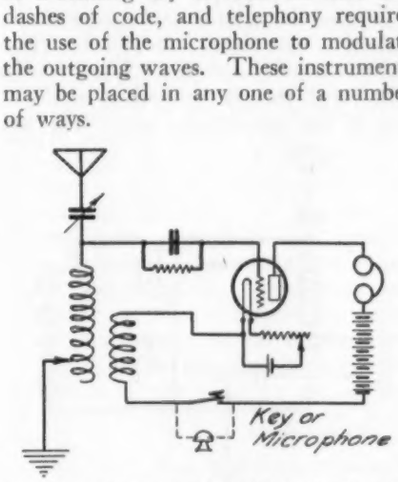


Fig. 5. Single Circuit Tickler-Coupled Set with Key or Microphone in Plate Lead.
This circuit should show ground connection for the filament.

In the simplest, the microphone and key may be inserted in the same place. We will therefore use one figure to illustrate telephony and telephone. In Fig. 5 is shown the single circuit tickler coupled set with a telegraph key or a microphone inserted in the plate lead. Suppose a telegraph key is used in that position. When the key is pressed for sending, the circuit is closed and oscillations are generated and sent out. When the key is not pressed, as between letters or words, the plate circuit is opened, and therefore there are no oscillations gen-

erated. Thus nothing is transmitted. Dots and dashes are sent out depending upon the time the key is pressed. Thus for a dash the key is pressed longer than for a dot, and the oscillations are therefore generated for a longer period of time than for a dot.

If a microphone is placed in the position of the key in the plate lead, and is spoken into, the current changes due to the speech is impressed on the radio current and in this way modulation is effected or speech is transmitted.

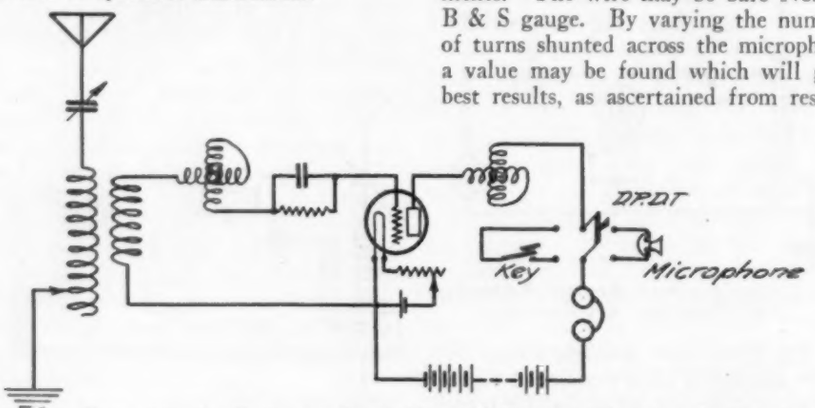


Fig. 6. Two Circuit Variometer-Coupled Set with Key and Microphone in Plate Lead.

The same method of telegraphy or telephony may be employed for the plate variometer type of circuit and for the two circuit regenerative sets shown in Figs. 3 and 4. If the beginner is ambitious and desires to have his set ready for either telegraphy or telephony he may employ a double pole double throw switch in the manner of Fig. 6. Here the two circuit variometer type of set is illustrated, though the method applies to any of the regenerative sets. The key

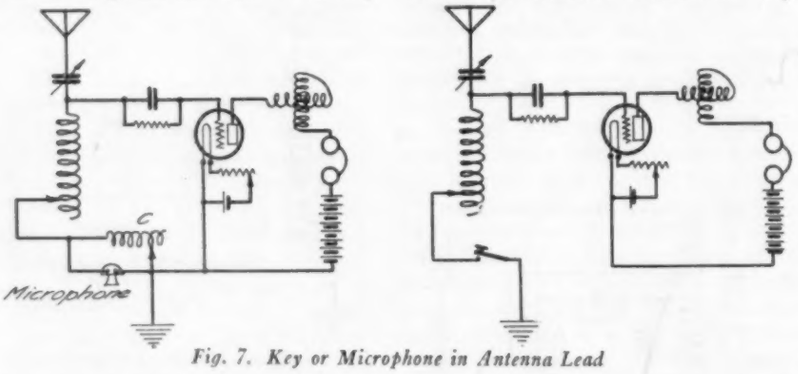


Fig. 7. Key or Microphone in Antenna Lead

is connected across the terminals of the switch on one side, and the microphone across the other. When the switch is thrown on the key side the key is in the plate circuit and telegraphy is available. If the switch is thrown on the other side then the microphone is connected in circuit and telephony is available.

Fig. 7 shows a more common and more favorite type of connection. Here the key or microphone transmitter is placed directly in the antenna circuit, thus directly interrupting or modulating the antenna oscillations by means of the key or microphone. The action is in reality the same as above, except that it is more direct, since the radiated waves themselves are altered by key or microphone, whereas in the above case they were altered indirectly through the influence of the plate circuit. As above, by using a double pole double throw switch both key and microphone may be used. In the case of telephony the following addition has been found to be of some marked improvement. Across the microphone is connected a small coil *C*, of about 5 turns, diameter say 1 to 1½ inches. The wire may be bare No. 14 B & S gauge. By varying the number of turns shunted across the microphone a value may be found which will give best results, as ascertained from results secured by people listening in. About 3 to 4 turns will be found best. This method of using the key or microphone in the antenna circuit is also suitable for any type of regenerative set.

A third and more advanced method of using the key and microphone is illustrated in Figs. 8 and 9. Fig. 8 shows the use of the key in the grid lead. The action of the key in this position may be briefly and simply described as follows: When the key is pressed for sending, the grid circuit is closed. Hence the charge on the grid leaks off by way of the grid leak and key to the ground or negative end of the filament. When this happens oscillations are generated and sent out by the antenna. When the key is not pressed the grid circuit is opened, hence the negative charge cannot leak off from the grid, because the grid leak circuit is open since the key is raised. When the negative charge cannot leak off oscillations cannot be developed, hence there is no transmission. In this way sending is accomplished.

In Fig. 9 the method of telephony is illustrated when the microphone is connected in the grid circuit, though indirectly by means of a transformer *T*. This transformer *T* is called the "modulation" or "microphone" transformer. Here the action is a little more complicated and need not be gone into. All that it is necessary to state is that the speech is transferred to the grid by way of the modulation transformer and in

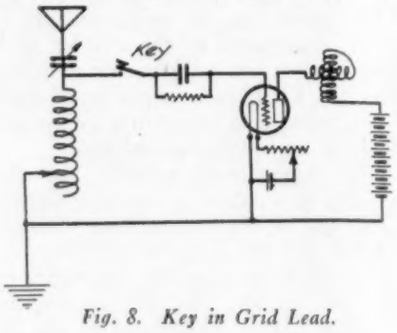


Fig. 8. Key in Grid Lead.

this way alters or "modulates" the radio waves and speech is thus transmitted. A direct current must be supplied to the microphone by means of a dry cell. The reason this method is given is that it will be one of the methods which the beginner will probably use in his more advanced sets and it is offered here more in the form of a suggestion for future work.

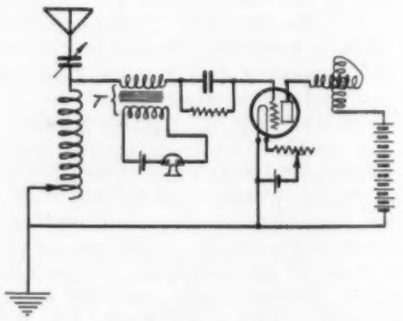


Fig. 9. Microphone in Grid Circuit through Transformer.

Of all these methods the beginner will find that the second one, namely where the key or microphone is inserted in the antenna directly as in Fig. 7, will give the best results. In this case the telephones may at the same time be connected in the plate circuit so that the operator will always be ready to receive.

This plan of using the receiver for a transmitter will give the beginner all the experience in transmitting which he can get from any other simple type of separate transmitter, at the same time saving him money. It is a small transmitter which is capable of giving some unusual results. It is advisable to use an amplifier tube, like the UV 201 or Cunningham C-301 with about 45 volts on the plate. It will not be surprising if a telegraph range of 20 miles or more is secured with this outfit, and frequently a telephone range of a few miles can be secured with the proper antenna.

What Do the Broadcast Fans Want?

By Carl Dreher

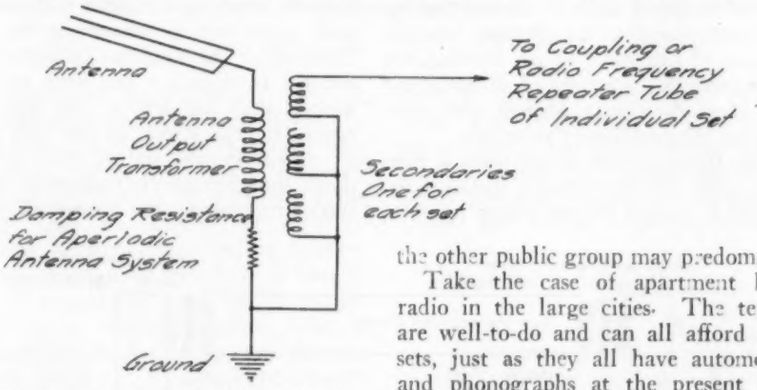
In the course of a discussion as to the probable trend of radio broadcasting the author here presents five practical methods for furnishing radio service to apartment houses or office buildings. He also shows that the most feasible plan is dependent upon the what is ultimately most wanted by the listener.

IS radio broadcasting to be a sport or a means of communication? On the answer to this question depend the solution of many of the problems now confronting the radio engineer and business man. It is hardly possible, at the present stage, to make positive predictions, but certain fairly plausible conjectures may be made. Radio, while unique in some respects, deals with the same public that supports the older, established industries of the country, and a consideration of the history and present status of these interests throws considerable light on what may be expected in the broadcasting field.

Broadcast listeners at the present time may be divided roughly into two different classes. The first class regards radio as a sport, as a very absorbing and fascinating game. The individuals in this class are largely distance fiends. They want to hear stations at the other end of the country. Most of them are interested in technical features; some build their own sets, others modify or tinker with the sets they buy. They make the market for the various new circuits—and old circuits newly-named—which crop up all over the country in bewildering succession. A fair number of them are potential code material; they flirt with the idea of learning the telegraph code and putting up a transmitter. They are, in short, carrying on the American tradition of being mechanically inclined, of knowing how the thing works, and if possible improving it.

The second class of broadcast listeners is more interested in the material broadcasted. They are literally broadcast listeners, while the distance fans should really be termed listening operators, since their strong point is skill in handling their sets, and if only they can get the DX station's call letters they don't care whether he is broadcasting Beethoven's Eighth in F Major, or Berlin's latest Blues. At the present time, as far as I am able to judge, the two classes are not far from equal numerically, if we include in the first those who want to do distance reception and learn about the works of radio, as well as those engaged in actual practice along those lines.

Of course these two classes of listeners overlap to a considerable extent and often the same individual may show the qualities of both divisions. Nevertheless it will clarify our thinking to realize that there are two such bodies with approximately the attitudes described. Having now examined these attitudes, let us apply our analysis to a concrete instance of radio development and note how an entirely different technical evolution may be expected according as the one or the other public group may predominate.



Plan 2. Common Antenna with Radio Frequency Distribution.

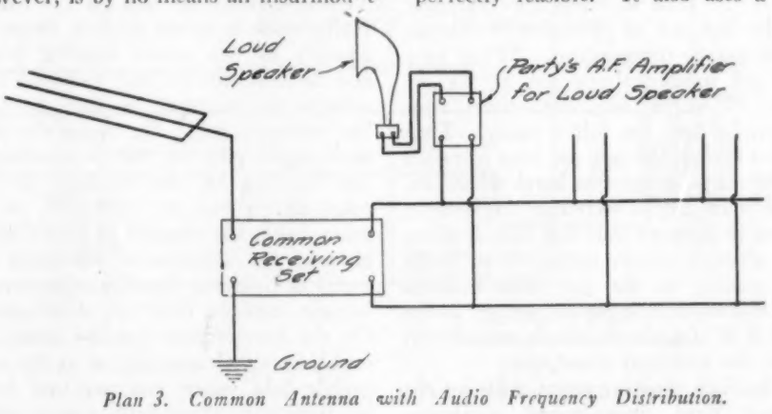
Take the case of apartment house radio in the large cities. The tenants are well-to-do and can all afford radio sets, just as they all have automobiles and phonographs at the present time. As yet comparatively few have invested. How are they to be served?

An individual outside aerial for each tenant is obviously impossible. There are some five other possible solutions. The first would involve individual library table loops or indoor aerials, with non-radiating receivers, for obviously as the number of listeners continues to increase if everyone is allowed to radiate the air will become a bedlam. This, however, is by no means an insurmountable technical problem, and non-interfering receivers not sacrificing the advantages of regeneration are being developed, and in the improbable event of failure other modes of reception can be resorted to—it is only a question of one tube more or less. This plan, in any case, follows the phonograph and other individual instrument idea. Each owner will tend his own apparatus—and the attendance required will decrease as more and more designers realize that they are building sets for the public, not for engineers—and pick up what stations he wants and can get, whether near or far. This might be termed the individual station plan, and it is the only one now in general use, though it will not necessarily always remain so.

Plan 1. Individual Loop or Indoor Antenna.

The second plan involves a single antenna with radio frequency distribution. Such systems have been patented and are in actual use in high power commercial radio work. Practically any desired number of sets may be fed from a single antenna system through coupling tubes, and the sets individually tuned without mutual interference, thus combining the advantages of a single collecting system and individual freedom. The technical disadvantages of wiring radio frequency all over a house will probably act as a deterrent to the development of this system for broadcast reception, unless the possibilities of static reduction by the use of a special form of collector should outweigh the drawbacks.

The third plan has already been installed in a number of locations and is perfectly feasible. It also uses a com-

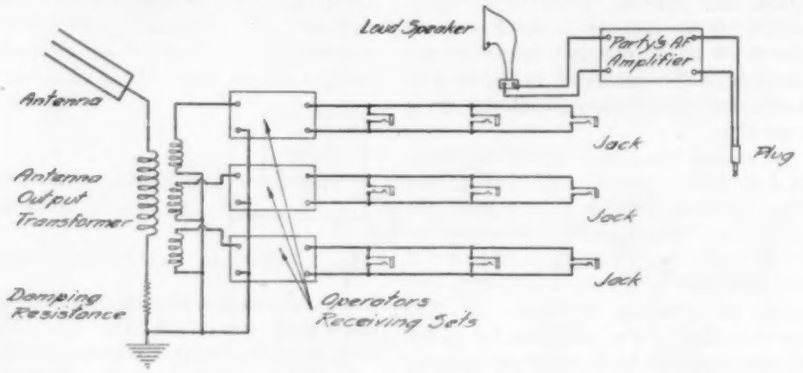


Plan 3. Common Antenna with Audio Frequency Distribution.

mon antenna, but distribution is at audio frequency. There is a single receiving set, which may be tended by the regular telephone operator of the apartment house, and the music is sent out to the individual tenants over an ordinary telephone line. With only one set and one program available, this system is too inflexible.

The fourth plan is a combination of the second and third. Fed from a single antenna on the roof of the house, there will be a number of receiving sets, say half a dozen, tended by an operator. Each set may be tuned to a different broadcasting station, and while one is taking in a serious lecture, and another a symphony concert, a third may be picking up dance music. Distribution is at voice frequencies, and of course the switching of the output of any set to any individual tenant's line presents no technical difficulties whatsoever. Tenants may call the operator and be switched from program to program to their heart's content, individual needs will be taken care of, and the apartment dwellers be relieved of the care of the apparatus, which may accordingly be made considerably more complicated than would otherwise be feasible. In the separate apartments there would be only a loud-speaker with probably a power amplifier, requiring no more adjustment than an electric light bulb. The tenant, after consulting the program announcement, would simply say to the operator, "Give me station 'WOW,' and get his jazz, and then have his line switched to station 'WOE' in time to enjoy the slaughter in the last act of 'Hamlet'." Or he might say to the operator, "What have you got tonight that's out of the ordinary?" as he asks the waiter confidentially how the fish is today. That such a system has not yet been installed in any large apartment hotel where expense is an item of secondary importance—and be it noted that this plan involves only a very moderate outlay—is probably due mainly to the fact that builders and real estate interests are not yet aware that it is a perfectly simple proposition from the technical standpoint.

The fifth plan is carrier radio on the electric light lines—wired wireless—with simple individual sets and a number of programs to choose from. This presupposes the development of this method of broadcasting. From the engineering standpoint this is practically a new job, for wired wireless has its own set of problems and there is not apt to be anything millennial about it. As a matter of end results this system is equivalent to the fourth plan, for there are a limited number of programs to choose from, and at the same time the individual user is relieved of the necessity for technical skill, in the one case by the employment of an operator, and in the case of line radio by the sending out of considerable amounts of directed energy from the central station, thus simplifying the problem of reception.

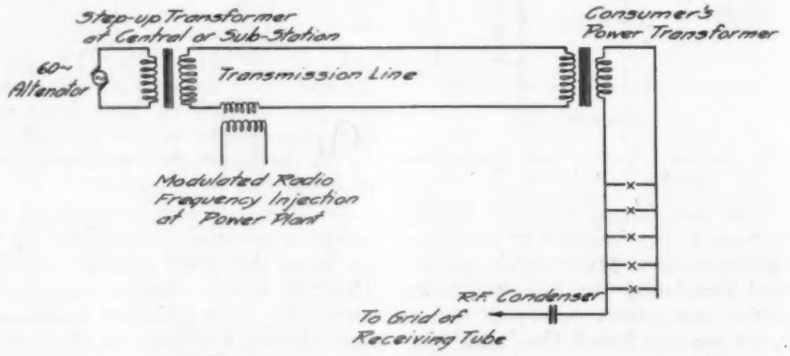


Plan 4. Single Antenna Feeding Multiplicity of Receiving Sets.

The thing to note at this point is that only under the first plan is distance reception a feasible or interesting proposition. The four other systems are immediately ruled out if what the tenants really want is to go soaring about the country or the world hearing remote and difficult stations and vaunting their prowess in reception as they do their low scores at golf. Of course the operator might pick up distant stations on one set, but to have it done for one takes all the fun out of it. If, on the other hand, the *content* of broadcasting becomes the objective of the great majority of listeners, then the other systems become possible fields of development. Or the development may be along several lines simultaneously, as in the automobile field, where one man may buy a machine with a powerful engine and a light body for racing, another a town car fitted primarily for show and luxury, while a third may invest in a Ford truck for delivering laundry. Whatever lines evolution may take, we see how the development of the art is conditioned by the factor of what the public wants, and by an analysis of present tendencies among the listeners we may forecast probable changes in radio markets and conditions.

It seems probable that sooner or later specialization will enter this field as it has entered every other one. One station will broadcast opera, music as advanced as the public—its particular public—wants to hear; another may specialize on educational features; another may get a reputation for putting out good vaudeville material; and so on. As tastes differ, so, after a time, stations may differ also.

There is undoubtedly a good popular field for operatic music and the like, but that is about the limit for the present. A great deal of twaddle has been written by well-meaning but sentimental people about the revolution in popular taste which radio will bring about tomorrow morning. Orpheus will triumph, and jazz will lie down in the rain. Nothing of the sort may be expected to occur. In radio we deal with the same people that we see at the opera, in trains, on the street, at the ball game, in movie shows—today; they will be much the same people tomorrow, and in speculating about the future of broadcasting we may as well bear that in mind.



Plan 5. Wired Wireless with Individual Sets Fed from Power Mains.

One field that invites discussion is educational broadcasting. Education seldom pays its own way, its benefits are apparent only in the long run, and hence it is generally subsidized or endowed. It would be a natural evolution if men of wealth, as they now establish foundations for medical research and professorships at universities, should in the course of the next decade begin to endow institutions of learning with broadcasting apparatus and funds for lectures on topics of public moment. In this way the present system of education may be considerably modified by radio in common with other social forces.

Hazeltine's Neutrodyne

By Six Zee Jay

This article tells how capacity coupling is neutralized in tuned radio-frequency amplifiers. Several hook-ups are given for trial by the experimenter. It is to be followed up by a constructional article.

WITH tuned-radio-frequency amplification, it has always been the tendency of the circuits to oscillate when the grid and plate circuits were in resonance. This has always been a drawback against tuned radio-frequency and accounts for the slow progress along this line. However, Prof. L. A. Hazeltine neutralizes the effect of this capacitative coupling so as to give tuned radio-frequency amplification, with all the advantages of resonant circuits. He says, "..... tuned radio-frequency amplification, is but one of a number of practical applications of a general principle: That electrostatic or capacity coupling between two circuits behaves like electromagnetic coupling in that it may be reversed in sense and in particular may be reduced to zero. This is accomplished by balancing one capacity against another. To attain the balance condition, it is generally necessary to reverse the phase of a voltage; and this involves the use of a transformer in addition to the capacities."

The neutrodyne receivers can be adapted to any method of amplification. Audio-frequency amplification or regenerative amplification, etc., can be added. However, in the case of regeneration, very little is gained by its use, in a properly designed neutrodyne receiver, when wavelengths above 360 meters are desired. But below these, on the amateur waves, a decided increase in signal strength results. If continuous waves are to be received, then, of course, it is necessary to produce regeneration for hetrodyne purposes.

In Fig. 1 is shown two stages of tuned radio-frequency amplification and an audion detector. The transformer coils are very closely coupled. The secondary is wound outside the primary and so screens away some of the coupling capacity existing between the primary coil of one stage and the secondary circuit of the preceeding stage. This reduces the capacity to be neutralized, as does also the fact that the respective transformers are not in magnetic relation, accomplished by arranging the transformers at right angles to each other. The transformers have a turn ratio of 1 : 4, and are wound with litz. The number of turns and the size of wire is best found by experimenting. If the experimenter who spent so much time with the Armstrong Super will spend half that time with this neutrodyne receiver, he will get better results, by far!

Two of these transformers, seen in Fig. 1, are used as radio-frequency transformers, while a third is used to tune the antenna and the first r.f. transformer. Tuning is accomplished by means of a small variable condenser of

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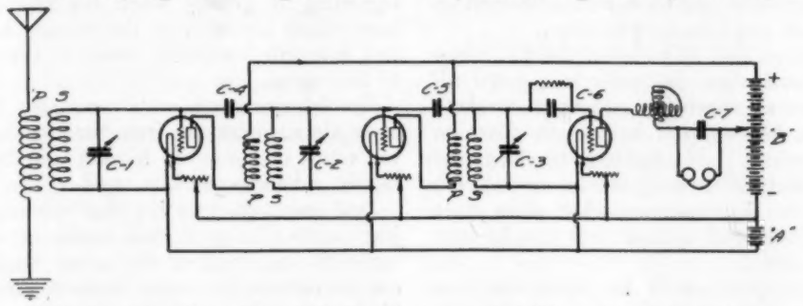


Fig. 1. Two Stage Tuned Radio Frequency Amplifier with Tube Detector.

C_1, C_2, C_3—11-plate variable Condensers.
C_4, C_5—neutralizing capacities equal about ¼ internal capacity of tube.
C_6—grid condenser with leak.
C_7—.001 mfd. phone condenser.

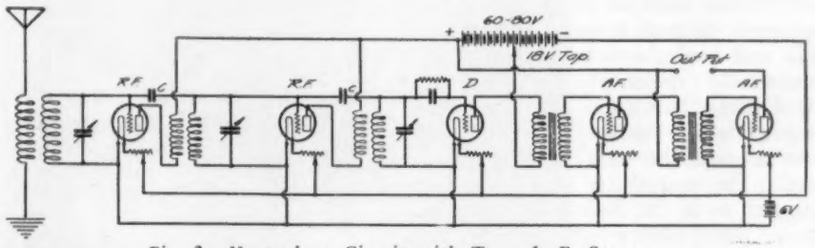


Fig. 2. Neutrodyne Circuit with Two A. F. Stages.

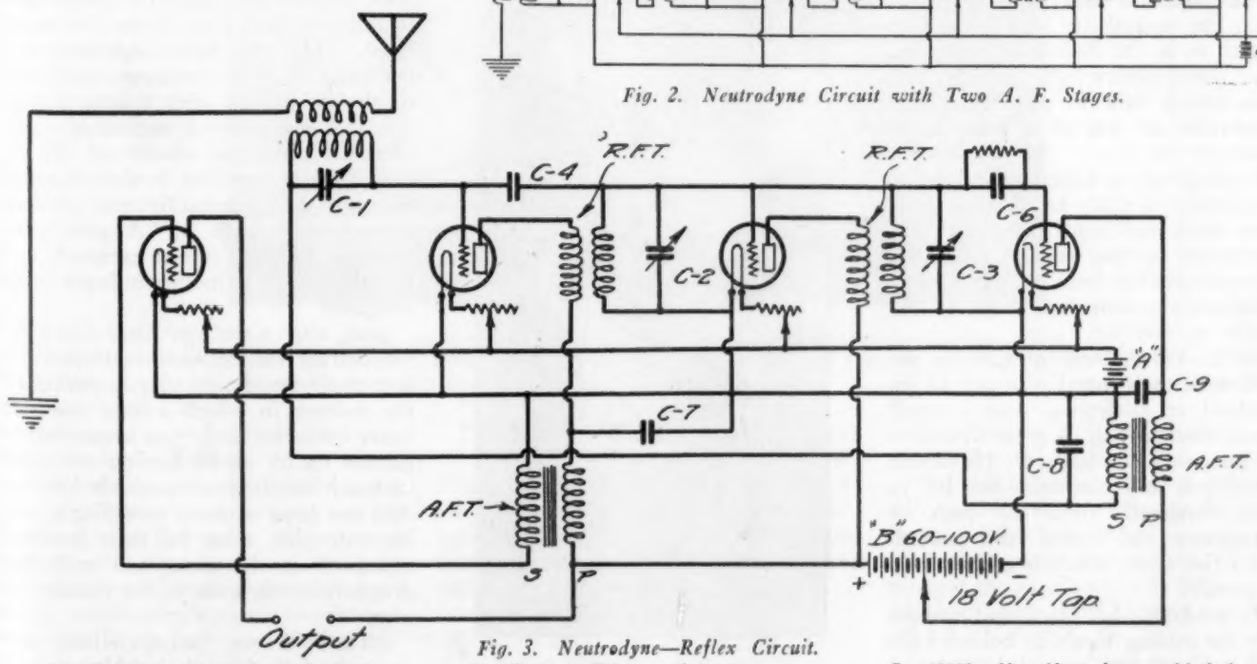


Fig. 3. Neutrodyne—Reflex Circuit.

C_1, C_2, C_3—11-plate variable Condensers.
C_4, C_5—neutralizing condensers.
C_7, C_8, C_9—.001 mfd. fixed condensers.
C_6—.00025 mfd. grid condenser with leak.

"And It Came To Pass ---"

Wherein Radio in the Rural Regions Receiveth Recognition

By Sewell Peaslee Wright

AND it came to pass that a dial twirler in the Ninth District was given a vacation, yea, even one week wherein the alarm clock alarmeth not, and the 7:48 car goeth by unheeded. And he, being human, rejoiceth exceedingly, saying:

"Yea, we will have one large time!" and he conjureth up happy images. He buyeth large assortments of fish-hooks, and a bathing suit of divers and brilliant colors. He even remembereth last year's vacation, and supplieth himself with anti-mosquito lotions to the extent of many bottles.

He worketh nights over the old bus, and tighteneth and tinkereth into the small hours. He even neglecteth his radio set to maketh the car fit for the journey, which showeth that it was indeed a matter of exceeding importance.

And the night before the day on which they were to start, he looketh over his set, and he thinketh unto himself:

"I must haveth a set to take with me!"

He diggeth accordingly into many boxes and containers of various sorts. He windeth two coils, and even maketh his alleged Lesser Half holdeth the reel of wire. He tappeth and soldereth; he boreth many holes in an old panel and mounteth thereon divers switches and dials and knobs, and he putteth it all into an old cabinet wherein a globular De Forrest bulb and the horse-shoe magnet which goeth therewith had once aroused the envy of a neighborhood. He maketh a lead wire that pluggeth in at the dash-lamp socket on his car wherewith to light the tube, and lo, he sitteth back in admiration, for his portable set was of a verity completed.

He pictureth to himself the joys of sitting under a shady tree and harkening to music and news from afar off; he rejoiceth in the baseball scores he will receiveth far from the cities, and he patteth the varnished sides of the portable in very joy.

And in the fullness of time he arriveth with the general manager of his household at a clearing near a small stream, wherein fish of great size were both numerous and hungry. He setteth many lines, and catcheth—but lo, ye scribe wandereth from the path of righteousness and radio, and starteth upon a fish story, which is neither meet nor seemly.

He pitcheth his tent and maketh ready the midday meal; he bolteth half-fried potatoes and canned beans, and calleth them good. He fighteth yellow-jackets and flies for every morsel, and lo, a yellow-jacket becometh angry at him, and sitteth down upon him violently, which discomforteth him exceedingly. And lest ye getteth me wrong, let me say that in the last phrase I referreth not to the yellow-jacket!

But all things cometh to an end, and finally a single wire of copper hangeth in all its beauty between two trees. An iron pipe extendeth into the ground, and maketh one, and lo, our hero hooketh up the set and prepareth to listen.

He picketh up a carrier-wave of pleasing audibility, and pulleth it down till music of exceeding sweetness breaketh upon his ear, and he settleth down to enjoyment. He lighteth his pipe and thinketh all is well, but lo, he knoweth not in his ignorance what is in store for him—and it is as well that he does not know.

No sooner doth he settle down to enjoy the concert than he seeth a figure approaching, and it turneth out to be the farmer who owneth the land. And he greeteth our hero cordially, saying,

"How be ye, young fellow?" and he evinceth great interest in the radio set.

Up to Date—
"Q. T. C. Madam?"

He accepteth an invitation to listen in, and expresseth wonder at the loudness and clearness of the voice. He smileth with childish delight, and marveleth audibly that such a "contraption" could worketh such wonders.

He departeth when the concert cometh to a close, and asketh many questions as to the evening's programs. And our hero, suspecting nothing, telleth him of all the schedules of nearby stations, regretting it greatly when his farmer host telleth him that in the evening he will bringeth his family down to listen to the radio.

For lo, one goeth on a camping trip to be alone, and away from the crowds; yet when one inviteth himself and his family, who can say him nay?

And promptly at eight that evening, just as the first good loud carrier wave whistleth in, a car of the genus Ford, not uncommon in certain sections, rambleth up, and from it springeth out three men, two boys, two women and a little girl. And one of the men steppeth forth and saith:

"Our friend on whose land you are, telleth us that thou hath a radio set, and of a verity we longeth exceedingly to heareth one, whereof we have heard much."

And, being a ham and therefore of exceedingly good disposition, our friend proceedeth with the help of his Mrs. to find seats for their guests, and to entertaineth them with phone music.

The men wondereth greatly, and spitteth forth much tobacco-juice in their excitement, and the little girl swalloweth her gum from the same cause. The two ladies squealeth like ten steps of audio-frequency, and fluttereth like a tube with a loose prong. The two boys grinneth exceedingly, yea, even till there was danger of the receivers being engulfed in their mouths, such was the greatness thereof. And as the reporters hath it, "A good time was had by all," if one excepteth our friend and his mother-in-law's only daughter.

And, after a space of time, they leaveth, fitting themselves into their Ford in a truly wonderous way, savoring of the manner in which a ham jammeth tuner, detector and two steps into a cabinet six by six by twelve, and with as much howling as resulteth thereby. And our hero rejoiceth exceedingly, and his wife also, when lo, their landlord appeareth on the scene, and with him divers relatives, even to the number of nine.

"Tune 'er up, young fellow, and show the folks how the gol-blame thing

Continued on Page 70

A Very Useful Receiver

By Major Lawrence Mott

Illustrated by Judson Starr

APHRODITE was her name! But she no more resembled her graceful namesake than is night akin to day!

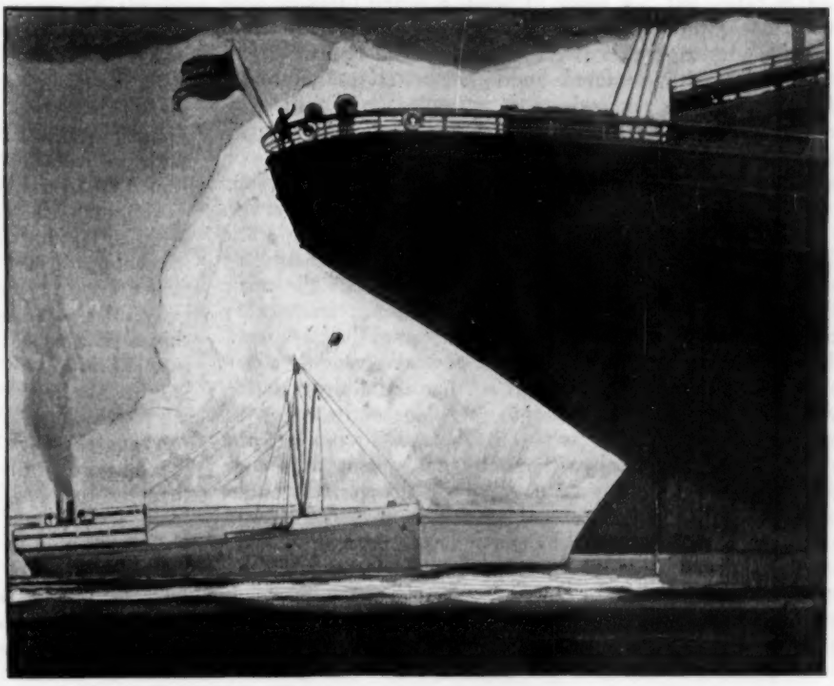
Stubby, high-sided, bluff-bowed, with a "tubby" stern—the mis-shapen little freighter was always good for several laughs along the waterfronts of the many Atlantic-coast ports in to which she peacefully ambled, from time to time, laden with nondescript cargoes, that Skipper Thad' Bronson picked up here and there, as luck came his way.

But the skipper took life as easily as his sturdy craft took the ocean's heaving breasts. In his time—for he was getting well along the average length of life's cruising—he had tucked away a comfortable bank account, and as he had neither kith nor kin—he worried not when times were slack, and the *Aphrodite* lay in some harbor, idly swinging to her anchor, waiting for something to turn up.

Thad' had one aversion: *the law!* Not that he had ever run a'foul of it, but he steered a wide course from anything that looked "queer." Many opportunities had been offered—strictly on the *QT*—to do a bit o' rum-running from the Bahamas—and Bermuda—at very fancy charter prices—but he always shook his head slowly—"I reckon that I can get along, com'ferable, without steerin' anyways near Uncle Sam—and the lock-up"—he was wont to chuckle.

And in this attitude his chief engineer, one William McWilliams, and as dour a little Scotchman as ever came "oot o' Dundee," concurred, what-tho' his ethically Scotch adoration for anything that savored of money often urged him to side with the rum-running tempters.

"Och-hai!" he would sigh. "Tae think o' sae mickle siller, lyin' round loose for the pickin' o' it—an' *no expenses!*"



"Nor did anyone see a little wooden box slip from his hands into the foaming pother under the steamer's stern. And not one noticed him wave his hand at a little freight vessel that lay nearby motionless."

"Yep! But with a damn' good chance of lettin' Uncle Sam pay our board bills, for a few years! We've got a clean record, and we'll keep it!" Thad' would grunt complacently. To that statement there was nothing more to be added!

A LOVELY June morning in Providence Harbor. Far and away—beyond the Light—the waters of the Atlantic stretched to seemingly interminable distances—under a cloudless sky. Tugs plied busily to and fro—the clatter and clang of teeming life along the docks—came clearly across the motionless surfaces.

Breakfast over — the skipper and the little chief sat on the spotlessly-clean bridge deck, under a spotlessly-white awning — for the *Aphrodite* was well found, and kept.

"I feel's if something'll turn up today, Mac!"

"Weel"—the other cocked an eye shoreward—"I'm no sayin' but that a carrrgo'd be vera welcome—aye!"

As if to prove the truth of the old adage: "forthcoming events cast their shadows before"—a very smart motor craft—a' glitter with brass work, saucily flying some Yacht Club's burgee at her bows, with the Stars and Stripes fluttering over her white-frothed wake—came tearing toward the *Aphrodite*, to slow down, close a'board.

"Hello — on the *Aphrodite!*" shouted a man in summer whites.

"Same to you!" Thad' replied.

"Can I come on board?"

"Nothin' to stop you—that I knows of!"—and the skipper went to the gangway to receive the visitor.

"Are you open for charter, Skip'?" enquired the yachtsman—cheerily.

"Never more open! Come up for-ard, and sit. Hot—here!"

"Better looking from on deck than

Continued on Page 54

Pleasure Boat Radio

By Paul McGinnis

Several suggestions are here given for the installation of receiving aerials on pleasure boats varying in size from canoes to yachts. These ideas are timely for those who contemplate a radio set as an additional source of pleasure during their summer vacation.

IN fair weather there is some doubt as to the relative merits of boating and listening-in as means of diversion, but doubt is dissipated in the light of recent discoveries which have coupled the two pleasures in a practical manner.

An antenna which will give good service with standard makes of receiving sets need be nothing more than an insulated wire dropped over the side of the boat. While the trailing form of antenna has been known for some time, it is one of those valuable radio secrets which refuses to leak out. At first thought it seems incongruous to throw an antenna in the water, still more so to let it dangle beneath the bottom of the boat where the ground connection is made, and when the average fan learns that it works when actually lying at the bottom of the sea he is sailing, he throws up his hands. Waterproof insulation is the secret. Almost any heavily insulated wire will work well for a time, but rubber insulation will withstand water longest. The free end of the wire can be insulated with sealing wax or with tape and paraffine. Rubber tape is best and it can be fixed permanently by vulcanizing or by applying "cold patches" of the kind used in mending inner tubes for automobile tires.

The submerged wire receives equally well whether the boat is moving or lying at anchor, and the depth of water makes no difference. Navy officials consider it practical for small boats, especially as auxiliary equipment. When used as an antenna for a submarine, it is strung on small masts with both ends soldered to the hull of the boat so that the steel hull helps it to form a loop. While part of the loop is short-circuited by the water, the greater conductivity of the metal enables a small current to be received by the loop.

While the trailing antenna used on a pleasure boat may act as a loop similar to that of the submarine at times, it has more of the nature of a counterpoise. A practical length is 75 feet. A greater length will bring in a slightly stronger impulse of the radio wave, but tuning will be more difficult.

A workable ground connection is easily made. It is necessary to have only a square foot of metal surface in contact with the water. In power boats, this ground connection can be the propeller, connected through some convenient part of the engine. In other boats anything metallic can be suspended in the water. As the ground connection is in itself something of an aerial or a counterpoise as the case may be, it is well to have it as large as possible, and metal ribs or framework should be connected in to make it more efficient. A strip of copper about four inches wide running along the keel might be called the perfect ground, but in most cases it would be an extravagance.

To use a crystal receiving set at any considerable distance from a transmitting station it is advisable to use an overhead aerial, which may take many forms, the inverted L and the T types such as those used on large vessels being quite the best. An aerial run from a single mast directly to the receiving set may give excellent results. Such a short aerial may be most effective when made of two strands connected at the free ends so that they form a loop.

The common form of indoor loop antenna is a favorite for boats which are large enough to carry it conveniently. It is made of about a dozen turns of wire around a framework some three feet in diameter. The wire can be bare or insulated. Somewhat better results are obtained with stranded wire, such as flexible lamp cord, than with single-strand wire, although the latter is practical and should be as large as possible. The loop is especially desirable in warm weather as an aid in overcoming static disturbances. A good loop can be counted upon to eliminate about half the static noises and the interference from other stations. This is accomplished by its directional effect, as it receives best when it is pointed so that the desired station comes within the plane of its coils. If used while the boat is in motion, the loop will require adjustment from time to time as the boat changes its course, but its adjustment is not critical, and slight changes will not perceptibly alter the strength of the sounds received.

As the loop can take many forms, it can be easily adapted to small craft so that it requires almost no space at all and is inconspicuous. It can be easily run around the sides of small boats, and in such a position, with its plane parallel to the surface of the earth, it will receive equally well in all directions. One or two loops, in this instance, will be sufficient, as a total length of 75 feet is best for the common vacuum tube receiver. With the better types of regenerative and super-regenerative receiving sets now coming on the market, a coil of but a few inches in diameter can be used.

For experimenters and others who are not bashful about having their equipment seen and think more of their radio than the stream lines and harmonious beauty of their boats, there are other types of antenna. The spiral is one type which is giving good results.

A wire 75 feet long can be formed into a coil a foot or more in diameter, depending upon the length it must stretch, and bound in place by three or four lengths of cord which serve to keep the coils properly spaced and to support the whole length of wire. When suspended from two masts, this type is directional in two directions. It may be wound about a single mast, however, in which case it will receive equally well from all directions.

An added advantage of the coiled antenna is its compactness. It is collapsible and takes up very little space. When extended to its full length it will always give the same response to incoming waves, and the same adjustment of receiving instruments can always be used.

The nearest perfect antenna is a kite string, and while it depends upon the wind for its support and is therefore not always reliable, it has been tested and found practical for marine aviators who wish to call for help when they are forced to land upon the water.

Height is one factor in the efficiency of an aerial, and as its effective height is its center, the kite aerial is the nearest perfect in this respect. It is possible to get results with fine wire, especially with this nearly perfect type of antenna, and a small kite will hold up a sufficient length. Better results will be had if a kite is employed which is large enough to support several hundred feet of string in addition to the antenna, for it will then rise to a height where the breeze is stronger and steadier.

For the crystal user, whose craft may be only a canoe and whose available equipment is limited, the kite is perhaps the easiest solution. With it he should hear broadcast programs over a distance of ten to twenty-five miles and perhaps much farther. While he is less apt to have good results with the trailing antenna, he may find it practical enough.

Recent developments in the manufacture of dry-cell vacuum tubes have aided considerably in adapting radio to the water. Long-distance receiving sets can now be weighed in ounces rather than in pounds, as the cumbersome and weighty storage battery can be discarded.

Small *B* batteries can be used, as they are used for voltage rather than for current. It is also possible to operate several tubes on one small dry-cell *A* battery.

The Properties of Radio Condensers

By Jesse Marsten

Most of the dependable literature on this subject is locked up in mathematical language unintelligible to the man or boy with a high school education. But the author of this article has the key to simple expression which unlocks the facts which ought to be known by every one who operates a radio set.

THE two principal elements which go to make up a radio circuit are inductance and capacity. An understanding of the properties of these two elements is therefore a fundamental prerequisite to a thorough knowledge of radio circuits. It will be the purpose of this paper to discuss in detail the subject of capacity.

A condenser consists essentially of two or more conducting plates, with an insulating medium called the "dielectric" between them. This apparatus has the ability to store in the dielectric between its plates a certain amount of electric energy. The measure of its ability to so store electric energy is called its "capacity." A condenser having a capacity of $2C$ can store twice as much electric energy as a condenser having a capacity of C, for a given voltage difference between its plates.

Inasmuch as condensers may be built with plates having a variety of shapes, separations, etc., it is out of the question to consider here the manner in which the capacity will vary with these different types of condensers. In general the following is true of all concentrated condensers: The capacity varies directly with the size of the plates, with the number of plates, and directly with a constant K called "the dielectric constant," which depends upon the material of the dielectric. For air this factor is unity, but for all other dielectrics this factor generally varies between 1 and 10. The capacity also varies inversely with the spacing between the condenser plates, the closer the spacing the greater the capacity.

Just as there may be a capacity between the plates of a condenser built as above mentioned, there exists also capacity between any two conducting parts of a circuit which are at different potentials, as for example between the turns of a coil, or the capacity between two conducting leads in a set. Such capacity is called "stray" or "distributed" capacity, as distinguished from the capacity of a condenser which is called "concentrated," "lumped" or "localized" capacity. A condenser is built by design to have capacity and is confined to a given definite space within the apparatus, while "stray" capacity is accidental, existing in a set by no premeditated design. This stray capacity is extremely objectionable in most cases due to the fact that it *is* stray, and therefore is not amenable to control, and is subject to great variations. Consequently good design tries to eliminate this objectionable type of capacity as much as possible and substitute in its stead the localized, concentrated capacity of a well built condenser.

Condensers may be classified in a number of ways, but for our purpose they may be considered as transmitting or as receiving condensers. Each of these classes may be further subdivided into fixed condensers and variable condensers.

Generally it will be found that transmitting condensers are seldom, if ever, variable, while receiving condensers may be either fixed or variable depending upon the purpose for which they are intended. Where any particular properties are possessed by any of the above classes these will be pointed out. However all condensers, regardless of classification, possess certain properties in common and these will first be considered.

The ideal condenser for radio purposes would have the following characteristics: The resistance of its plates would be absolutely zero; the resistance of the dielectric would be infinite (hence there would be no leakage of current through the dielectric); there would be no absorption of energy by the dielectric; the current will be a maximum when the voltage is zero, and the current will be zero when the voltage is a maximum; that is there will be a phase difference of 90 degrees between current and voltage; the capacity will be constant irrespective of changes in temperature, voltage, frequency and so on.

Such an ideal condenser does not exist, but the nearest approach to it is a well constructed air condenser. The plates of a condenser must, of course, have some resistance, but by using heavy material having high conductivity, this resistance may be reduced to a negligible quantity. However the little resistance that the plates do have immediately results in altering the phase angle of the condenser, i. e. there is no longer the ideal difference of 90 degrees between current and voltage. Air is the best dielectric, there being very little energy lost in the dielectric, and the capacity of an air condenser being practically constant with frequency. As a result air condensers are generally used as capacity standards for measurements and comparisons.

The chief imperfections of a condenser, apart from the resistance of the plates and leads to the condenser plates reside in its dielectric.

(a) **Change of condenser capacity.** A condenser should have a constant capacity regardless of frequency, temperature, or voltage applied to it. The air condenser conforms to these requirements, but other dielectrics do not. It is found that the capacity of a condenser, other than air condensers, is smaller at higher frequencies than at low frequencies. Thus measurements of capacity made at low frequencies are not always reliable when applied to calculations at high frequencies. In the same way there is a slight alteration of capacity with temperature and voltage.

(b) **Leakage.** The current flowing through a condenser should be a true capacity current, namely one flowing by virtue of the capacity effect and not due to any resistance effect. However, due to the imperfection of the dielectric, it may have some conductivity and hence there will be some flow of current which is a conduction current flowing through the resistance of the dielectric. This current, or leakage, results in a total loss of energy. Not only may there be a leakage of current through the dielectric but also across the surface of the dielectric between the plates.

(c) **Dielectric Absorption.** This is really the chief and most important source of condenser losses. When a voltage is applied to an ideal condenser it is charged instantaneously, and when it is discharged it discharges instantaneously. In the case of solid dielectric condensers something else happens. When the voltage is applied to the condenser an instantaneous charge flows into it but immediately thereafter there is a small continuously decreasing current in addition which flows into the condenser and seems to be absorbed by it. This represents an energy loss which appears as heat.

(d) **Brush Losses.** These occur only in the case of transmitting condensers which are operated at high voltage. At high voltages ionization of the air occurs and leakage of current takes place at points favorable to it, namely, where there are sharp edges. This leakage is made evident by a thin bluish discharge and when this brushing is really powerful the ionization is accompanied by the production of ozone. This is also a considerable factor in condenser losses, especially where high voltages are used.

All of the above imperfections and losses exist in both transmitting and receiving condensers, except the last which is solely a transmitting condenser phenomenon. They all result in increasing

the effective resistance of the condenser, and therefore the losses. The extent to which they increase the losses depends upon the frequency of the current, and may be generally represented as increasing with the wave length. The importance of minimizing these losses will be more apparent from the following discussion of effective shunt and series resistance of condensers.

Equivalent Effective Resistance of Condensers

An ordinary condenser has all of the above described losses, and all of these losses combined may be considered to be due to a certain resistance in series with a perfect condenser having the same capacity as the imperfect condenser under discussion. Thus suppose we have an imperfect condenser having a capacity of 0.004 microfarads, in which there is a current of 5 amperes at a frequency of f cycles per second, and suppose that the total energy loss in this condenser due to all the above mentioned causes is 25 watts. Then since power is given by the product I^2R, where I is the current and R the resistance of the device, we may assume that our imperfect condenser is equivalent to a perfect condenser having capacity of 0.004 microfarads with a series resistance equal to I^2R/I^2 or in this case 25/25, or 1 ohm. In other words such a condenser has an equivalent series resistance of 1 ohm. The greater the losses in the condenser the larger will be this equivalent series resistance of the condenser. Hence the greater effect it will have in diminishing the power in the circuit.

The losses in a condenser may also be considered from the point of view of an equivalent shunt resistance, namely, the imperfect condenser is considered to be equivalent to a perfect condenser of the same capacity but with a high resistance leak in shunt within which all this energy is dissipated. Thus suppose the voltage across our condenser is 5000 volts, and the shunt resistance is r ohms. The energy lost in this resistance is given by the quotient E^2/r, hence in our case we have 25 watts equals

$$E^2/r, \text{ or } 25 = \frac{25 \times 10^6}{r}$$

from which r is found to be 1,000,000 ohms. Thus the shunt resistance is found to be very great while the series resistance producing the same effect is found to be small.

The relationship between the equivalent shunt and series resistance of a condenser is a definite one which may be derived mathematically, but which need not be gone into here. The result of this analysis is given here, however, as

$$R = \frac{1}{\omega^2 C^2 r}$$

in which, r is the shunt resistance of the condenser, R the equivalent series resistance of the condenser, C the capacity of the condenser and ω the periodicity of the current. In other words in calculations we may consider either the series or the shunt resistance of condensers since they are equivalent in their effects when properly reduced by the above formula. An important conclusion to be drawn from the above formula is that *any* shunt resistance across a condenser is equivalent to a series resistance. Thus if for any reason a leak develops across the top terminals of a condenser, even though it be outside the dielectric, there will be a loss of energy due to this leak being equivalent to a series resistance. Thus suppose a series antenna condenser is used in a transmitting set. If this condenser is not properly insulated between its terminals there may be a leakage of current between its terminals which leakage is the same as inserting a resistance in series with the antenna and hence will diminish the radiation current. Or if due to poor insulating material, say, or poor soldering flux being spread between points of different potentials, a leak develops in a set, this leak will also be equivalent to a series resistance which will diminish the output of a transmitter or considerably reduce the audibility factor of a receiver. In regenerative sets it is conceivable that this leak might be equivalent to such a high series resistance as to prevent regeneration. The importance of avoiding poor condensers or poor insulation, or the development of possible leaks in sets is therefore obvious.

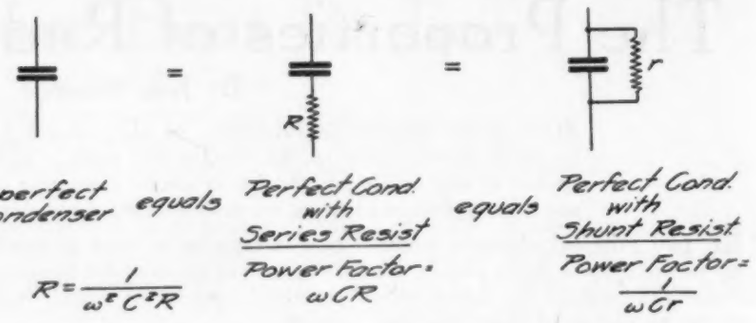


Fig. 1. Power Factors of Condensers

Power Factor of Condensers

The term which most easily expresses how good or bad a condenser is is the "power factor" of the condenser. Power factor in ordinary alternating current work is a measure of the energy expended in a circuit. Likewise when used for condensers it expresses the percentage energy expended or lost in the condenser. For an ideal condenser the losses are zero, hence the power factor is zero. Thus the nearer the power factor of a condenser is to zero the better is the condenser. Power factor may be expressed in terms of the series resistance or shunt resistance and is given by the the following equations: (See Fig. 1).

In terms of series resistance

$$\text{Power Factor} = R\,\omega\,C$$

In terms of shunt resistance

$$\text{Power Factor} = \frac{1}{r\,\omega\,C}$$

Thus if we have a condenser whose capacity is .01 microfarads, and whose series resistance is 2 ohms, at a wavelength of 300 meters it will have a power factor of

$$\omega \times RC = 2\pi \times 10^6 \times 2 \times 0.01 = 12\%$$

which indicates that the losses are 12% in that condenser. The problem of keeping down the power factor of a condenser is identical with that of diminishing its losses and thus reduces to that of increasing the efficiency of the dielectric. Air is the best dielectric except for transmitting condensers where extremely high voltages are used, as high as 10,000 to 20,000 volts. The dielectric strength of air at atmospheric pressure is too low to withstand such voltages. Air at high pressures is capable of withstanding high voltages, since the dielectric strength increases with the pressure, and high pressure air condensers are sometimes used. However since the specific inductive capacity of air is small very large sized air condensers must be used to obtain a given capacity. This makes them cumbersome and they are not much used.

Until recently glass was much used as a high voltage dielectric, the familiar Leyden jar being a typical example of a glass condenser. However these have disadvantages. In the first place the dielectric losses in glass are quite considerable; secondly, they have considerable brush and corona losses around the edges of the dielectric; and thirdly, they are easily breakable, resulting in considerable renewal expense.

The mica condenser has proved to be the most suitable as it has a very low power factor, its losses being almost as low as that of air. Then due to the high dielectric strength of mica the condenser can be built to withstand extremely high voltages. Its high specific inductive capacity enables a condenser to be built having high capacity in very small space, making these units very convenient and easy to handle.

Liquid oils are often used as condenser dielectrics, especially in air variable condensers. A good grade of mineral oil

has fair dielectric properties, and it has the added advantage of self-healing when a break down occurs. In the event the voltage between the condenser plates becomes too great and an arc-over results in a solid dielectric the condenser is spoiled, since the solid dielectric has been pierced by the spark. In the case of oil dielectrics new oil immediately flows into the space at which the breakdown occurred and the condenser is in perfect shape again. Of course, if the breakdown is so serious that carbonization of the dielectric occurs then the condenser is spoiled. Otherwise the oil dielectric is self-repairing.

The breakdown voltage of radio condensers depends upon the dielectric. But this breakdown voltage is not constant and is subject to different conditions from breakdowns at constant voltage. In general the breakdown voltage for radio frequencies is less than for direct currents. In the first place the dielectric of a condenser is subject to greater losses at radio frequencies than at direct currents, hence it heats up more due to these losses, and since the insulating properties of dielectrics deteriorate with increase of temperature the breakdown voltage is less at radio frequencies. Secondly, there occurs at radio frequencies a cumulative effect which is not present when direct currents are used. When a direct current voltage is applied to a condenser it may be applied for a long period of time without any breakdown occurring. Time is no factor, assuming that the voltage applied is not higher than the breakdown voltage. In the case of radio frequencies this is different. While the condenser may not breakdown in the first minute of the test if it is steadily applied it may breakdown a short time after the initial application. This is due to a cumulative effect of losses occurring in each cycle of the alternating voltage. The losses in each cycle heat the condenser, this in turn results in a deterioration of the insulating properties, which in turn results in greater losses and greater heat, which again results in deteriorating still further the insulating properties, etc., until the time is reached when the dielectric breaks down under this accumulated strain. It is for this reason that condensers which have apparently withstood high voltages for a long time suddenly break down.

The above details apply of course to all types of condensers but have special and particular application to transmitting condensers. Since these have to withstand high potentials they are generally built with fixed capacities, so that there are no movable parts, excepting of course the oil variable condenser. The plates are generally square or circular in shape, and the number of plates or size is determined simply by the capacity of the condenser to be secured. If a condenser is to be built which has a low capacity and which must withstand high voltages it is built of a large number of sectional capacities in series with each other, so that the high voltage is distributed over a number of condensers in series, thus reducing the possibilities of breakdowns. If a condenser is to be built which is to carry a heavy current then it is built of a number of sectional capacities in parallel with each other, so that the current is divided up into a number of smaller currents in parallel through each condenser, thus avoiding the possibility of overheating. If a condenser is to be built having a high current carrying capacity and to withstand high voltages then it is built of a combination of sectional capacities connected in series and in parallel so that the proper conditions are met.

Receiving Condensers

When we come to a consideration of receiving condensers the difficult problems of high current and voltage capacity are absent, since the current and voltages met with in receiver work are very minute. However, the energy involved is also minute, hence the problem of losses is extremely important, since the received energy is so small that losses cannot be well afforded. As a result air condensers and mica condensers are used practically exclusively, and of the two air condensers preponderate. This eliminates the problem of reducing the dielectric losses. The actual ohmic resistance of the condensers is reduced by using good conducting material for plates and leads, and making leads as short as possible. Losses due to corona effects are not present. However there is one source of loss which is important and which is often present in the cheap type of condenser turned out today. The dielectric losses of a condenser are not confined to the dielectric of the condenser proper, but some losses are contributed by insulating material which may be in the condenser electric field. Thus any insulating bushings, and insulating supports or posts in the construction of the condenser may be the seat of considerable losses, if the material of which they are made is a poor dielectric. Care should therefore be exercised in the choice of such materials and none but the best used.

The fixed condensers generally employed are made of mica and are the best. While paper and paraffined paper condensers are satisfactory for cheap sets, only mica condensers are recommended for the better type of set.

The variable air condenser most commonly used consists of a number of fixed semi-circular plates and a series of rotating semi-circular plates which interleave. Thus the rotating plates may be so revolved that the fixed and rotating plates are completely interleaved, in which case the capacity of the condenser is a maximum, or they may be partially interleaved, or they may not be interleaved at all when their capacity is a minimum. Between the minimum and maximum positions the plates may assume all capacities between minimum and maximum capacities, depending upon how much they are interleaved. Such condensers are rated by their maximum capacities, as 0.0005 microfarads. Since the plates are semi-circular it requires a rotation of 180 degrees to vary from minimum to maximum, hence condensers are provided with scales reading from 0 to 180 degrees. The capacity at any given setting of such a condenser is proportional to the angle of rotation, as in Fig. 2. Hence if a curve is drawn

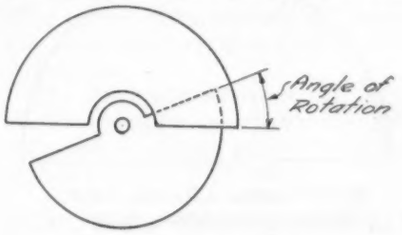


Fig. 2. Angle of Rotation

showing the variation of capacity with rotation angle it will have the appearance of curve in Fig. 3. It will be observed that this curve is a straight line through almost its entire range except at the start and end. There is a certain edge effect which gives the condenser some capacity in spite of the fact that the plates are not interleaved and this is indicated by the small curvature at the beginning and end of the capacity curve. Where a condenser is required having a uniform variation of capacity, therefore, such a condenser as above consisting of semi-circular plates is suitable.

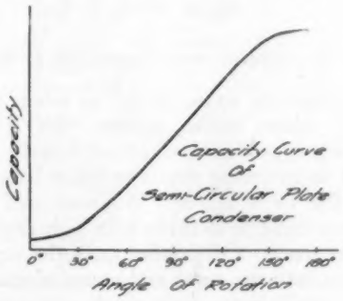


Fig. 3. Variation of Capacity with Rotation

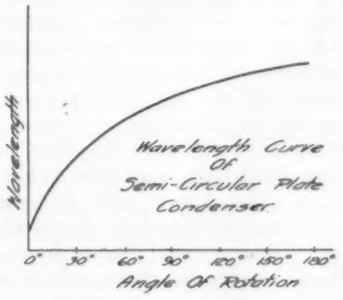


Fig. 4. Variation of Wavelength with Rotation

When such a condenser is used in conjunction with an inductance coil to make a wavemeter or a receiver which is to read wavelengths the following results will be obtained. The wavelength formula, namely

$$\lambda = 59.6 \sqrt{L C}$$

shows the wavelength to be directly proportional to the square root of capacity. The curve showing how the square root of capacity varies with the angle of rotation is shown in Fig. 4, which therefore also shows how the wavelength will vary with the angle of rotation of the condenser. This curve shows that at the smaller values of capacity, with small angle of rotation, the wavelength varies rapidly with the angle. That is, a small increase in the angle of rotation produces a large increase in wavelength. Hence at the lower end of the scale, if a wavemeter scale is to be placed on the condenser, the readings will be crowded together. Due to this crowding, errors are liable to be introduced. At the upper end of the scale large increases in the angle of rotation produce smaller changes in wavelength. Hence the readings will be separated far apart on the scale, that is the scale will

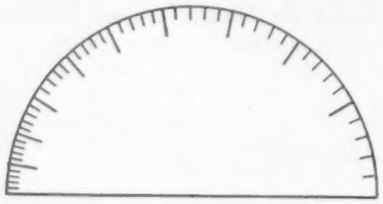


Fig. 5

be more open. Thus the particular curvature of the wavelength curve for this type of condenser shows that a non-uniform scale of wavelength readings is obtained in which the readings are closely crowded together at one end, and widely spaced at the other, as in Fig. 5. This is extremely undesirable from the point of view of accuracy and convenience in calibration work.

What is really required for wavemeter work is a condenser which will give a uniform wavelength curve, namely, a curve such that the wavelength varies uniformly with the angle of rotation of the condenser. Since the wavelength varies as the square root of the capacity it is necessary to design the condenser so that the capacity varies as the square of the angle of rotation, in which case we will have the wavelength varying uniformly with the angle of rotation. To secure such a capacity variation requires especially shaped plates for the condenser, and Fig. 6 shows the form of condenser plates which will meet the above requirements. The stationary plates are of the usual semi-circular form. The rotating plates are specially shaped as shown according to a definite mathematical formula, and the shaft is eccentrically located as seen.

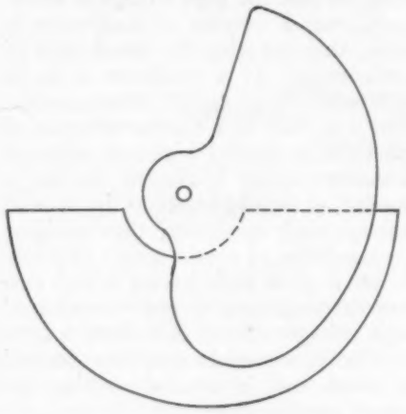


Fig. 6. Shape to Give Uniform Capacity

Such a condenser gives a capacity variation curve as shown in Fig. 7, curve *A*, while the wavelength variation curve is shown in Fig. 7, curve *B*. It will be seen from these curves that although the capacity varies non-uniformly, the wavelength varies uniformly with the degree of rotation, thus enabling more accurate calibration of the scale. Hence for wavelength work these plates should be used in order that a uniform scale result, while for capacity measurements a condenser standard should be designed having semi-circular plates both for rotor and stator, thus securing uniform capacity variation.

Certain precautions in variable air condenser design are worthy of mention. Rigidity of construction is of first importance if constancy of capacity is to be secured. All parts must be securely fastened so that motion of plates will not produce any loosening of parts, otherwise capacity variations will be produced. It is preferable not to employ

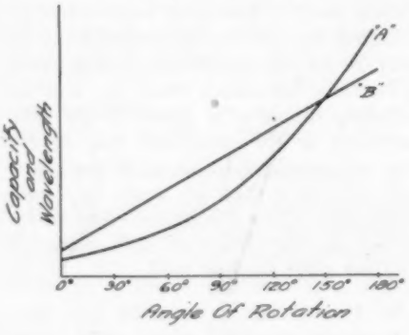


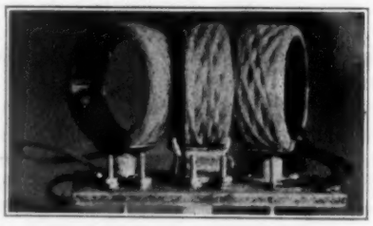
Fig. 7. Capacity and Wavelength Curves

stops for the rotor plates, as when the rotor plates strike against the stops jarring is produced which ultimately results in loosening nuts and hence loosening the rotor plates. Washers used as spacers must be uniform to a high degree of accuracy. Otherwise, since the separation between rotor and stator plates is very small, rotor may touch stator and thus produce short circuits. For the same reason condenser plates must be true and level, as any warping may result in rotor touching stator. The insulation used must be of the very best having low dielectric losses, and at the same time should have low specific inductive capacity, in order that the zero capacity of the condenser be a minimum. Often one finds a condenser which at zero setting has very high capacity. This is due to poor design of plates which are spread too close to each other and also frequently to the use of insulating material having high specific capacity factor. Leads inside condenser should be very short to minimize capacity and inductance.

MOUNTING HONEYCOMB COILS

By C. L. TICE

Honeycomb coils are known to be the best for long wave work, but some people do not like the method of mounting. It is rather inconvenient, sometimes, and calls for some feeling around to get the stations you want even when you know about where to look. The following method obviates that, is decidedly convenient and successful. The picture illustrates the method and appearance when made as a unit.



Convenient Honeycomb Mounting

A piece of brass rod the right length, 3/16 or ¼ in. in diameter, has a curved brass plate riveted and soldered to one end, to which the coil is fastened with linen thread. Short leads of flexible cord are soldered to the coil ends and the joints held by the same thread binding. In my setting, there are terminals soldered to the other ends of the flexible cords.

The bearings for the two coils are brass plates with short pieces of ⅜ in. rod soldered to them, holes are drilled to fit the shafts used. The central coil is mounted on a small block and is fastened with a strap of aluminum. The mountings are all the same height. The coils I use are, 75 turn RG for primary and secondary, 100 turn for the tickler. By mounting them with terminals, several styles of hookup can be experimented with. The spacing of the two outside coils is 3 1/16 in., center to center, which allows one to use the standard 3-in. dials on the front of the panel. The settings can then be logged, and any one picked up at once any future time. The coils are out of the way, protected from dirt and violence, and a handier construction would be hard to imagine.

Navy Converts Spark Apparatus Into Modern Tube Equipment

By Lieut. Jennings B. Dow, U. S. N.

IN carrying out the policy of economy established by the present administration, the Radio Section of the Bureau of Engineering, which has operated under the able guidance of Commander S. C. Hooper ever since the section was established, has come to the front with a plan for utilizing practically everything in the standard Navy spark transmitters to make up equally powerful tube equipment. The modification of this equipment includes everything from the smallest ½ kw. quenched spark sets to the largest in use. This will mean the reclaiming of many hundreds of thousands of dollars worth of radio apparatus and will entail a saving of as much public money.

The achievement is noteworthy for two reasons; first, because of the saving in money which is involved, and greatest, because of the example set by the Radio Section in finding a means to an end which was necessary in view of the curtailment of expenditures imposed upon the Department by the aforementioned policy.

It is difficult to state just how much the plan set forth in the preceding paragraphs may mean to the experimenter-reader, but it is certain that he will find that much of the spark apparatus which has been cast aside, as evidenced by the corpulent state of the classified advertising columns of the radio magazines, can be reclaimed in the manner followed by the Navy Department, and to that end, this article has been prepared.

Practically all Navy spark apparatus operates from a motor-generator source of 500 cycle alternating current and at primary voltages not greatly different from the usual 60 cycle supply used by experimenters, i. e., 110 or 220 volts. The secondary voltage of Navy spark transformers has a value of 12,500 volts which is, more or less, standard for all powers of transmitters, and the altering of the transformers to obtain the well known voltages of 500, 1000, 2000, etc., used in vacuum tube equipment resolved itself into a choice of connecting the secondary pies of the transformers in parallel, or rewinding the secondaries for the new voltages, as circumstances required.

The same procedure can be followed by amateurs, since in most cases, the output of ¼, ½, and 1 kw. transformers is sufficient to supply a 5 or 10 watt set, 50 or 100 watt set, or a 250 watt set respectively. The iron cores of many amateur spark transformers may not readily adapt themselves to the new use because of the low cubical iron content, but any coming from a manufacturer of repute should adapt itself to the change without difficulty. Many articles have appeared on these pages on the subject of transformer design and construction, and the reader will find, with slight interpolation, almost any information desired in the matter of converting his spark transformer by consulting these articles.

If a transformer lends itself to the method of paralleling the secondary pies to obtain the required secondary voltage, the following words of caution are given. Care should be exercised to connect the pies properly in order that one section does not short-circuit another. Ordinarily, transformer secondaries may be short-circuited for short periods of time with no harmful results and for this reason, the "cut and try" method of establishing the proper connections may be used.

Fig. 1 is a wiring diagram of a converted Navy spark set in which practically everything of the original equipment except the spark-gap was used. Many parts of importance but of small expense such as grid-leaks, filament rheostats, radio-frequency chokes, etc., had to be added. The diagram is that of a ½ kw. spark set, converted into a 100 watt tube set employing two 50 watt Western Electric tubes. Many similar unconverted spark sets are for sale by the Board of Survey, Appraisal and Sale, Navy Dept., Washington, D. C., at fabulously low prices as compared to the original cost.

In this particular set, the original motor-generator and controls, meters, transformer, condensers, wave-changer, antenna loading coil, and panels were only slightly changed, if at all. The oscillation transformer was removed, resulting in space for two 50 watt tubes and sockets; the antenna loading coil was used for the dual purpose of providing the necessary input and output inductances for the tube set; the spark-gap was removed, resulting in space for the filament ammeters and rheostats. Plate current milliammeters, grid leaks, and radio-frequency chokes were added as necessary.

The result was the conversion of an obsolete spark set into an efficient 100 watt tube set which radiated in excess of 100 watts of C-W energy.

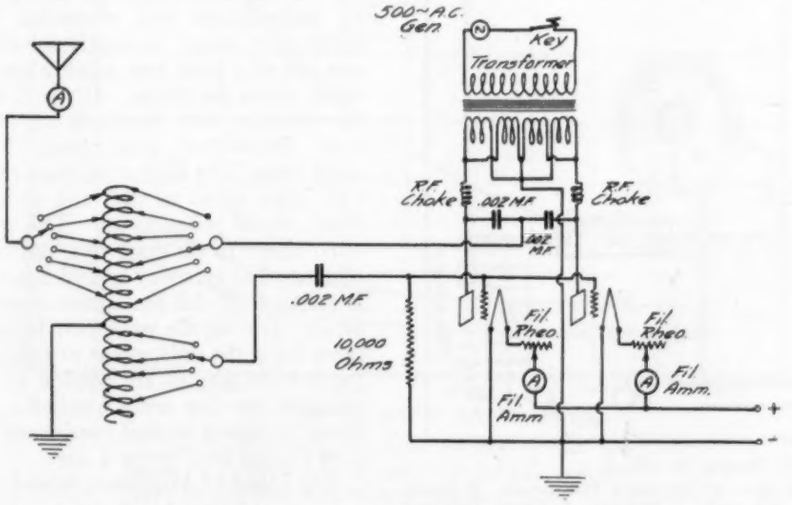


Fig. 1. Wiring Diagram of ½ K. W. Navy Spark Set Converted into 100 Watt Tube Set.

AUDIO FREQUENCY AND DOUBLE REGENERATION

By JOSEPH W. GEOFF, 4PG.

PERHAPS there is nothing in the wireless game that has played as important a part as the so called regenerative circuit. With out it, almost all amateur long distance work and phone reception would be impossible and C. W. transmission would never have reached the position it now holds. An experimental circuit with audio frequency regeneration is shown in Fig. 1. This

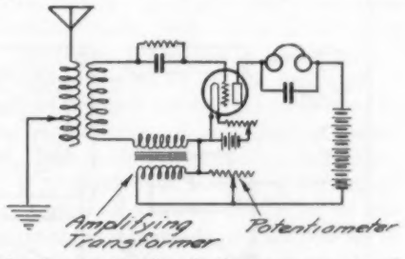


Fig. 1. Hookup for Audio Frequency Amplification.

makes use of an ordinary amplifying transformer with the primary in the plate circuit and the secondary in the grid cricuit. A potentiometer is connected across the primary in order that the coupling may be varied by adjusting the resistance of the potentiometer to the point just below the oscillating point

for that tone frequency. When used for phone reception this coupling may be adjusted once and need never be changed, thus simplifying operation. When used for telegraphic reception great selectivity can be obtained by tuning the spark frequency of the transmitter or the beat

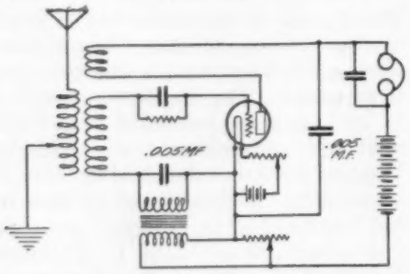


Fig. 2. Hookup Using One Tube as Detector A. F. and R. F. Amplifier.

tone obtained from a C. W. transmitter by the use of a heterodyne. All this tuning is accomplished by the adjustment of the coupling. Interference due to static is thus partly eliminated.

Another circuit that has given me much satisfaction is shown in Fig. 2. It is seen that one tube acts as detector, r. f. amplifier, and a. f. amplifier. This is by no means new, but principally because of the absence of data on the subject it has rarely been experimented with by amateurs. Some say that it is very unstable but I have come to the conclusion that when properly constructed it is sufficiently stable to be operated even by the novice. It gives much stronger reception than either audio or radio frequency regeneration and combines the advantages of both. Spark, phone and C. W. come in equally well thus making this a set for both the novice and the advanced amateur.

It is to be seen that an ordinary r. f. feedback is used. The same type of a. f. feedback coupling as was used in the set shown in Fig. 1 is used except that the primary and secondary must be shunted by a condenser of from .001 to .005 mfd. capacity in order to by-pass the radio frequency currents. In the diagram I have shown nearly all the resistances, inductances, and capacities as variables, but this is not absolutely necessary, as when once adjusted they require no further attention throughout the life of the tube. It is best to use a hard amplifying tube —I have had best results using an A. P. amplifier or a Western Electric V. T. II. In principle and operation this set is so much like the ordinary type that I think it requires no further theoretical explanation.

In assembling this type of receiver care should be taken not to run wires parallel to each other and to keep the apparatus in the plate circuit separated from those in the grid circuit. In experiment I have found it best to mount the apparatus on a board. This makes for short leads and keeps the various instruments accessible for adjustment or changes. A suggested layout is given in Fig. 3.

A RADIO ENGINEER'S EXPERIENCE IN THE PHILIPPINES

By C. A. REBERGER

SEVERAL new stations have been erected in the various islands of the Philippine group and a general description of them is given herewith, thru the courtesy of William H. Howard, Radio Corporation engineer and once noted amateur, who supervised the building of a chain of stations in the Philippines. It will readily be seen that radio has made great strides in that group of islands and is to be considered a necessity, and of great value.

While the station was in the course of erection on the island of Culion, Mr. Howard and his party had the "pleasure" of residing near one of the largest leper colonies in the world. At that period there were some 7,000 sufferers in detention, the majority of whom were Filipinos. We can readily imagine the strenuous conditions the engineers had to work under while constructing this station.

The new station is rated at 1 kw. and is the only means available for establishing communication with the outside world, for no cables connect it with the mainland.

The aerial is of the T type, made up of six wires. It is supported by two self-supporting steel towers 200 ft. in height and spaced 100 ft. apart. Ground connection was made by burying heavy copper cable 18 in. In the power house will be found the condensers, motor generator and transformer.

The outfit is of the quench gap type. Provisions have been made so that communication can be carried on over a range of wavelengths anywhere from 300 to 1,200 meters. The operators, all natives, doctors and other persons who care for the unfortunates, have a little village of their own, fenced off from the rest of the island. The life of an operator at Culion is not one filled with pleasure, for there is nothing to wear away the great monotony.

The 20 kw. station at Bantangas was the largest and most powerful of the group. The ten wire antenna is stretched between two 200 ft. self-supporting steel towers, spaced 600 ft. apart. It is situated on a high bluff overlooking the harbor. Two 50 hp. oil engines drive the motor generators. These engines are cooled from a specially built fountain, which was constructed just outside the building. A counterpoise takes the place of the regular type of ground and was built only after much difficulty. It consists of thirty poles, inserted deep in the sandy ground, insulated on the top, and the many wires stretched between, with the cross wires spaced 100 ft. apart. It is 75 ft. above the ground.

It is not uncommon for this station to communicate with Australia, some 2,000 miles away. Recently the station was put to a good test, when a typhoon swept across the island. It struck without warning and hundreds of houses were demolished, some being blown miles away. The high wind took several very large sheets of steel and deposited them several miles away. The aerial, often blown in the shape of a half moon, threatened to give way several times, but in spite of all this the station remained intact. During the week that followed, radio being the only means of talking to the outside world, an average of 800 messages per day were handled. The fifteen operators worked continuously almost twenty-four hours a day.

The island of Mindanao, second larg-

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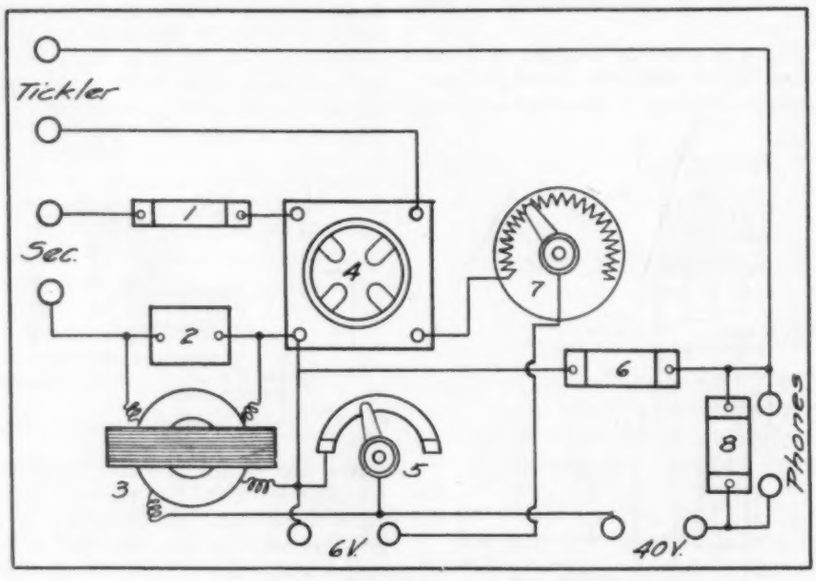


Fig. 3. Suggested Layout for Hookup on Fig. 2.

1. Grid Condenser .0005 mfd. 2. By-Pass Condenser .005 mfd. 3. Amplifying Transformer. 4. Socket. 5. Potentiometer 4000 ohms. 6. By-Pass Condenser .005 mfd. 7. Rheostat. 8. Phone Condenser .001 mfd.

Limitations of Litz in Transmitting Circuits

By Lieut. Jennings B. Dow, U. S. N.

AS a result of an investigation by the Navy Department, some time ago, of the excessive heating of Litz inductance coils placed in the downcoming leads of a multiple tuned antenna being operated with a tube transmitter radiating 20 amperes at a wavelength of 800 meters, it was found that the heating resulted from the resistance of the Litz, which, in this particular experimental installation was resurrected from a supply of this conductor originally designed for use in arc set inductances, where currents of lower frequencies (longer wavelengths) are employed. In this connection, it is interesting to note that it is practically impossible to construct efficient Litz which has been designed for use in power oscillating circuits operating at frequencies above 300,000 cycles per second.

Considering that the depth of penetration of the current into the conductor is

$$d_p = \frac{10^4}{\pi \sqrt{0.4\, K\, \mu f}}$$

where K is the conductivity of conductor material, and the *effective resistance of unequal current distribution*, or *thermal resistance* is

$$R_1 = \frac{1.98\, l_1}{c} \sqrt{\frac{\mu f_1}{K}}\ 10^4 \text{ (ohms)}$$

where l is the length of the conductor, and c is the circumference of the conductor. It would be theoretically bad practice to employ in the individual conductors composing the Litz, a wire larger than No. 40, where frequencies greater than 300,000 cycles per second (wavelengths shorter than 1000 meters) are used.

Since the effective resistance of unequal current distribution is proportional to the square root of the frequency, and the radiation resistance is proportional to the first power, it is *folly* to even consider the manufacture of a Litz which would have any advantages over a well shaped solid conductor in transmitting circuits where currents of any magnitude are flowing at the frequencies used by experimenters (wavelengths below 300 meters). At these frequencies, the design of conductors is a most cumbersome mathematical operation, and the difficulties of design are small when compared to the problem of manufacture. At a frequency of 1,000,000 cycles per second, the losses resulting from the imperfect dielectric qualities of the insulation alone, outweigh practically all of the advantages of this particular type of conductor, and the poor thermal conductivity of the insulation results in such a temperature rise within the cable that almost twice as many individual strands are required as are demanded by the ordinary principles of design, which results in additional difficulties.

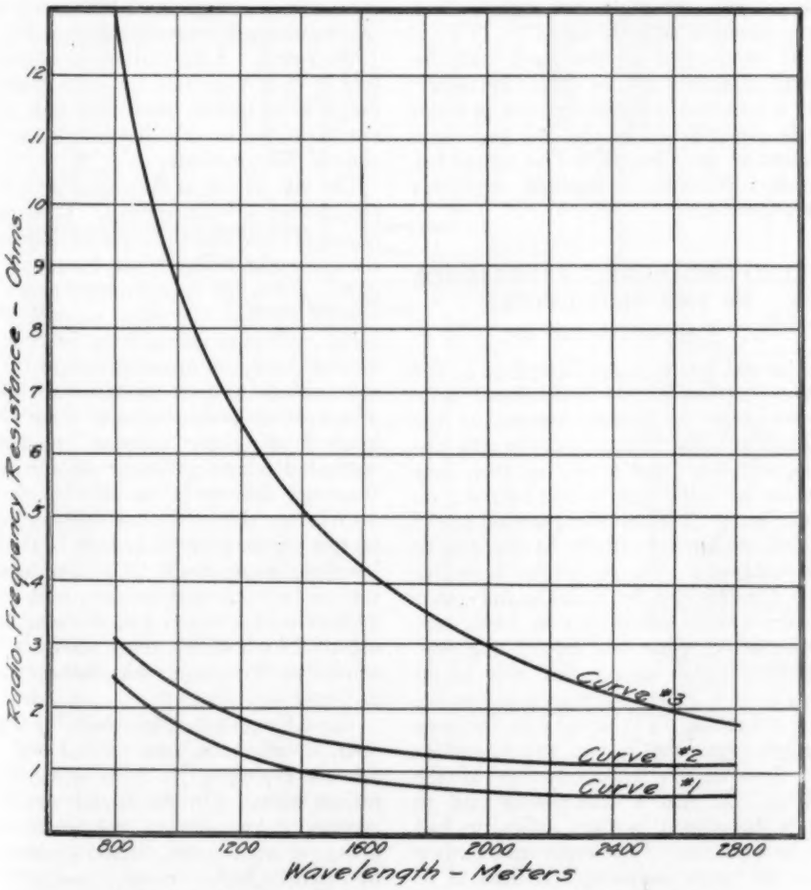


Fig. 1. Radio Frequency Resistance of Bank Wound Litz Coils.
Curve 1.—3x16x38 Litz, 3 cables in parallel, twisted.
Curve 2.—3x16x38 Litz, Single Cable.
Curve 3.—24x28 Litz.

It is interesting to note the results of tests of various conductors, which were made at the Naval Radio Research Laboratory. Four conductors of the following construction were tested. These conductors had a considerable length and were each wound upon a radio compass coil frame, and in an identical manner.

(1) No. 10 solid copper wire.

(2) Litz, 3 by 16 by 38, 3 cables twisted.

(3) Litz, 24 strands of No. 28 wire.

(4) Litz, 42 strands of No. 31 wire.

Measurements were made at wavelengths between 800 and 4000 meters. The No. 10 solid copper wire showed the lowest radio-frequency resistance in all cases, followed by the other conductors in the order mentioned.

An additional test was made of the following conductors, bank wound upon a coil form having a diameter of 4 in.

(1) Litz, 3 by 16 by 38, 3 cables twisted.

(2) Litz, 3 by 16 by 38, single cable.

(3) Litz, 24 strands of No. 28 wire.

Length of wire on each coil, 70 to 80 ft. Fig. 1, shows the results of this test.

The radio-frequency resistance of 300 ft. of the 24 by 28 Litz when spaced on the radio compass coil frame was only 2.62 ohms at 1200 meters, while the resistance of 75 ft. of the same conductor, when bank wound on a coil form 4 in. in diameter, at the same wavelength, was 6.47 ohms, or, per unit length of wire nearly 10 times the resistance. Nothing could more fully demonstrate a contention borne out by mathematical proof, of the effect on the resistance of radio-frequency conductors occasioned by the introduction of an imperfect dielectric such as that of conductor insulation.

If the individual strands of Litz could be separated without insulation of the commercial nature, then Litz would be Litz and our present methods of design would hold.

It should be understood that what has been said, applies more strictly to the use of Litz in transmitting circuits. The use of small Litz in receiving equipment is urged, for in this case, the conductor current densities are small, and the potentials available for charging the dielectric are not so marked.

A Cheap but Efficient I. C. W. Transmitter

By Everett H. Gibbs, 1 A. A. C.

To meet the demand for information about economical apparatus to replace spark sets, as recommended by the Second National Radio Conference herewith are directions which can easily be followed by any amateur. It is designed for either alternating or direct current.

IN these days of CW transmission, there has been much demand for a CW transmitter that will have a good working range, but that will not prove too high in cost for the average amateur. The transmitter here described was designed primarily for the man who has no city current at his disposal, but those who have it and cannot afford a larger transmitter may make use of this outfit.

The apparata needed for the set are as follows: a 5-watt transmitting tube, a 2½ ampere rheostat, a .001 mfd. grid condenser, grid leak, a .0005 mfd. variable condenser, two inductances, and a condenser to prevent sparking in the base of the tube.

The circuit diagram is shown in Fig. 1. This circuit was used because

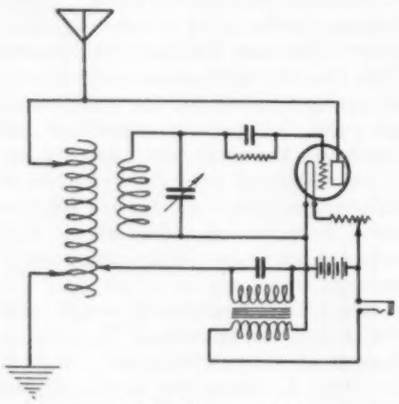


Fig. 1. Circuit Diagram for I. C. W. Transmitter

it is a constant oscillator and is easily tuned to the legal 200 meters.

The antenna inductance consists of 30 turns of No. 18 wire on a cardboard tube 5 in. in diameter, wound so that every turn is reached. The grid-tickler coil is 20 turns of bell wire on a tube 4 in. in diameter, and tapped at 10, 15 and 20 turns on the inside. The coupling between these coils is not critical; simply place one inside the other.

Either ac. or dc. may be used to light the filament of the tube and to supply the coil. Any size of spark coil rated at less than one inch may be used. The writer has found that an ordinary Ford coil gives as good results as any other, and can be used in this circuit without changing any of its parts.

A radiation ammeter is desirable, but if the operator cannot afford one, a 2½ volt flashlight bulb in series with the antenna will tell when the outfit is working. However, for the best results, an ammeter reading up to 1 amp. is necessary.

Some difficulty might be experienced in getting this set working, but if the operator observes the following points he should have no trouble. First, tune in a large part of the antenna inductance and all the turns on the grid coil. If there is no radiation after tuning, reverse the leads to the grid coil and tune again. Even though the set radiates, it is often advisable to reverse the leads to the primary of the spark coil, since one side of the secondary gives a higher positive charge than the other, and reversing the primary leads has the same effect as reversing the secondary leads.

Regarding the performance of this transmitter, one should be able to radiate at least ½ amp. without crowding the tube and with a counterpoise. The radiation with a ground is considerably less.

The daylight range of the outfit is up to 100 miles, and the night range at least three times this distance. The writer has worked 700 miles with ease thru QRM, at night and signals have been reported at 1400 miles.

If dc. is used on the spark coil, the outfit may be used on phone by inserting a low resistance microphone in series with the primary of the coil and short circuiting the vibrator. The writer has worked 40 miles in daylight with this arrangement.

RADIO ENGINEER'S EXPERIENCE IN THE PHILIPPINES

Continued from Page 30

est in the group, is considered to be the most interesting. It is inhabited by a queer race of people known as the "Bogobos" and "Sabanos" who still employ the bow and arrow as their sole means for killing game and carrying on their wars. The northern section of the island is devoted chiefly to the raising of cocoanuts. The population is thrifty but handicapped by malaria and other fevers which constantly play havoc, exterminating many and costing the government great sums. On this island was built a 2 kw. station, similar to the one at Culion. The aerial is of the same design, supported by two towers similar to those at the other stations of the group. It was a tremendous task to erect this station, as many difficulties had to be overcome. The apparatus, cement for the tower supports, etc., had to be transported several miles from where the ship lay. Many of the roads were in such a deplorable condition that a gang of natives had to be hired to carry the material to the location. This caused a considerable delay.

Mr. Howard and his party next proceeded to Bosio, the most northerly island, 300 miles north of Luzon. It is the region of many nasty typhoons, and earthquakes are felt at short intervals. Due to these setbacks the natives are cautious and construct their homes in a queer manner. The walls are made of a special cement, being 3 ft. thick, while the roofs are built of thatched grass and almost 7 ft. in thickness. Yet in spite of all this, the buildings offer little resistance to the storms. Naturally, with such conditions, special attention was given the construction of the masts. At this station, 100 ft. tubular steel masts take the place of the self-supporting type. This type of support is bound to offer less resistance and in case they are blown down, the loss will be small or another one may quickly be erected. Several times since the birth of the station the masts have been blown down and the operating quarters badly wrecked. This station is rated at 2 kw. and works on wavelengths varying from 300 to 1500 meters. Like Culion, communication is mostly carried on with Bantangas. That station then forwards it to the mainland or it's destination, as the address may indicate.

On the island of Mindoro was next constructed a 5 kw. station. This transmitter is likewise of the quench gap type, the generator being driven by an oil engine. Two 150 ft. self-supporting steel towers support the four wire T type aerial. Arrangements have been made so that communication can be carried on over a wide assortment of wavelengths. The native operators spend their "off" hours hunting the "tamorao" or pigmy water-bull, known as one of the most ferocious animals in the world, or the dwarf deer, one of the smallest and most perfect formed deer known. Besides handling island traffic, this station also acts as a relay station and each year transmits or receives hundreds of messages. Much of it's relay traffic is forwarded to Bantangas, the central station of the group.

Should one visit the island of Palawan, he would be sure to find real adventure exploring its many great, mysterious caves. On this island was built another 2 kw. station, the aerial used being a two wire affair, supported by two tubular masts, spaced 100 ft. apart. It has taken an important part in bringing the various islands into closer proximity, well demonstrating its usefulness.

Changing Over a Spark to a Tube Set

By E. M. Sargent

Herein is told how to construct a simple C. W. set out of a spark set. The only new apparatus necessary is a tube and a power transformer, the design for which is shown. With such simple information and such small expense there seems to be no excuse left for a spark set.

THE development of the vacuum tube for transmission in the last two years has radically changed the type of transmitting set used by the amateur. Prior to 1921, every amateur took pride in his spark transmitter. C. W. was practically unknown. However, soon after the present transmitting tubes were made available to the amateur, it was discovered that by using a single 5-watt tube, communication was easily possible over distances of 1500 miles and more. It was also found that five or six stations in one city could carry on DX communication without interfering with one another when using vacuum tubes. The majority of amateurs were quick to take advantage of this improvement and at the present nearly 90 per cent of the amateur transmitters are either d.c. C. W. or a.c. C. W.

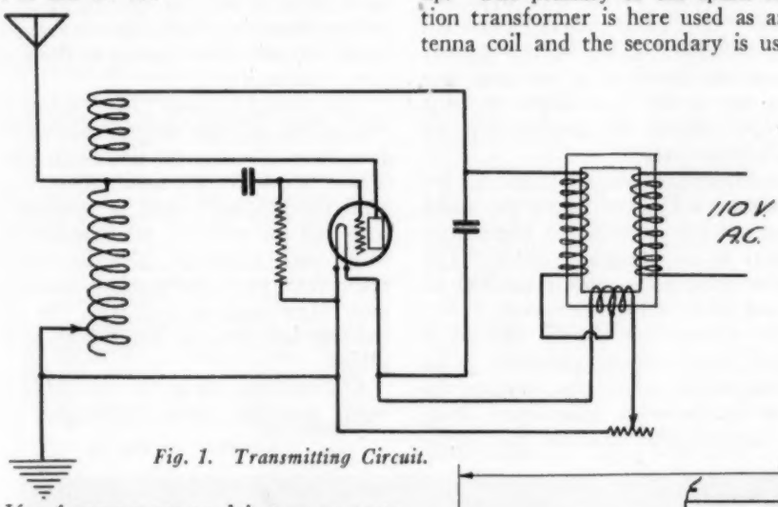


Fig. 1. Transmitting Circuit.

If a farmer were to drive an ox cart down the middle of a state highway (assuming that an up-to-date farmer would own one), it would not be long before people traveling in more modern vehicles would put him off the road. Although the farmer might have a legal right to drive the cart wherever he pleased, according to our American conceptions, he would have no moral right to inconvenience a large number of people, even though he could not afford a more modern conveyance or enjoyed the ox cart more. It is decidedly up to him to get off the road and stay off until he can arrange to travel in such a way as not to inconvenience the great majority.

The spark amateur is in exactly the same predicament. When a powerful amateur spark station is working, it is utterly impossible for any other amateurs, within a radius of ten miles, to carry on any DX communication. Everyone must sit and wait until this one "air hog" gets through. Why the great majority are willing to put up with this nuisance is one of the unsolved mysteries of the present day.

The purpose in writing this article is to show one method by which most of the parts of any spark set can be used in a simple but efficient a.c. C. W. set. Incidentally, the writer should not be construed as favoring this means of communication as a way to eliminate interference. It is an improvement over the spark—an improvement of about 100 per cent—but is still a long way from perfection. However, it is so much better than the spark that for the present at least it merits serious consideration.

Fig. 1 shows the circuit. If the power transformer were replaced by a pair of phones and a *B* battery, it would be the familiar single-circuit regenerative hookup. The primary of the spark oscillation transformer is here used as an antenna coil and the secondary is used as a plate coil. Their positions are exactly the reverse of what they are in a spark set. The antenna coil should have at least ten turns on it. It may, therefore, be necessary to add a few turns to the spark O.T. The condenser across the high voltage transformer can be one section of the condenser that is used in the primary oscillating circuit of the spark set. This condenser is in the circuit for the purpose of by-passing the high frequency around the iron core transformer. Its capacity can be anything between .001 and .01. The grid condenser can be another section of this same condenser. Its capacity, also, is unimportant and can have any value between .0005 and .01. The grid leak should be about 5000 ohms. Any vacuum tube can be used. The size of the filament rheostat will depend upon the filament current drawn by the tube.

The design of the power transformer is fully shown in Fig. 2. This is the only part of the a.c. C. W. set that must be built out of new material. The transformer is designed for operating one to four 5-watt tubes.

As in any other tickler coil set, the plate inductance must be in the right direction before the circuit will oscillate. It will probably be necessary to reverse the leads to this coil in order to determine which is the proper way to connect it. With a single 5-watt tube, this set should give enough radiation to ensure communication over distances of from 500 to 1500 miles.

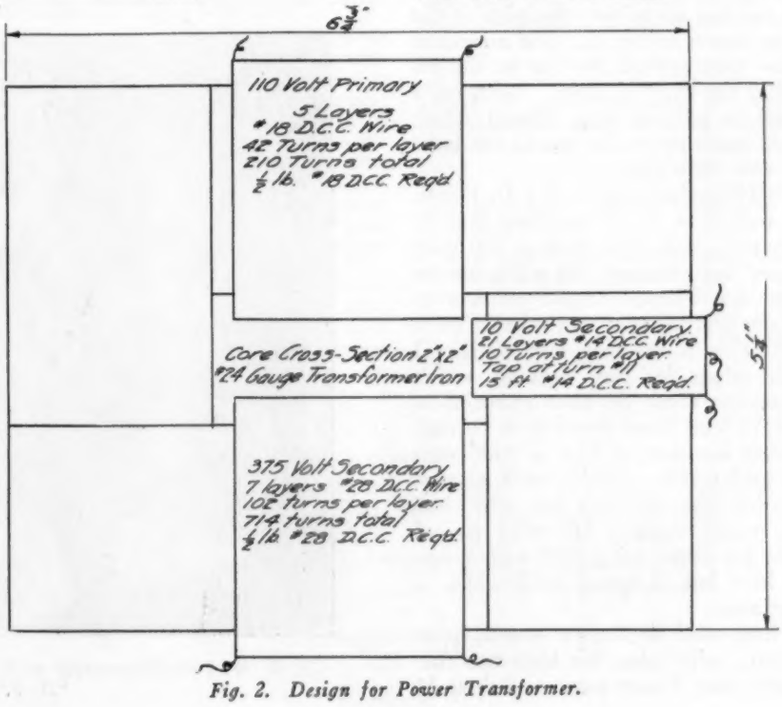


Fig. 2. Design for Power Transformer.

How to Get 50 Watts Out of a 5-Watt Tube

By Lyndon F. Seefred, Radio 6EB

THOSE who cannot afford tubes larger than 5 watts and would like to get 50 to 100 watts output, can do so easily without much expense, if they will follow these directions:

First obtain a pint Mason jar and also a pint of "Magnet Transoil." Then use a heavy pointed knife to loosen the brass seal around the porcelain base of the tube. Cut the prongs off with pliers and then work whats left back and forth until it breaks loose from the wires. Take out the porcelain and cut the brass down about half way with tin

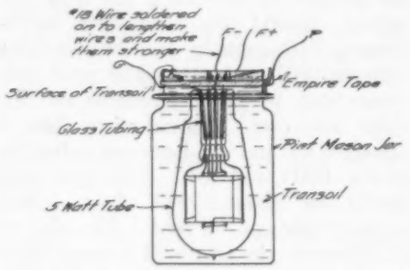


Fig. 1. Section showing 5-Watt Tube in Oil

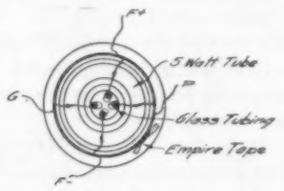


Fig. 2. Plan of Connections.

snips. If there is no glass tubing over the wires, put some on as it helps to keep the high voltage from jumping across. Empire sleeving would work OK but small glass tubing is better. Now set the tube in the jar as shown in Fig. 1 and run the wires over the edge of the jar as shown in Fig. 2. Tie a strip of empire tape around the top of the jar to hold the wires in place. Then use a funnel to pour in your transoil which should come up to the top of the brass seal or a little above.

I am experimenting with a Radiotron five watt tube in oil and find that by using *only* 1500 volts from a 600 watt "Acme" transformer, 150 milliamperes, I get 3.5 Thermo-Couple amperes in the antenna, using a synchronous rectifier. This is the maximum voltage I would advise for easy working, which is equal to about the same radiation as most 50 watt tubes running at normal. In some instances, as high as 2000 volts was used which gave 4½ to 5 amperes radiation, but the plate gets white-hot. This would equal a 100 watt set. I would not advise using 2000 volts unless you have lots of money with which to experiment.

I have tried all kinds of stunts, hook-ups, etc., with tubes, but blew two condensers, four 5 watt tubes, and three 50 watters. So others can learn at my *past* expense. I found the reversed feedback circuit to be the best and most efficient circuit for short wavelengths. Do not use a by-pass condenser in it and you will get plenty of milliamperes which I found put the punch behind the "sigs" more than high radiation and low mils. Made several long distance tests to prove this. Using only 1000 volts, but 400 mils. on a 50 watt tube, I worked 8ZY (Defiance, Ohio) just like rolling off a log and was copied the same instant at 3BLF (Richmond, Va.) who stated that my "sigs" were coming in like a local eastern station.

Larger tubes can be placed in oil also, to give more than double power.

RADIO ON THE S. S. "MAJESTIC"

By C. A. REBERGER

THE recent launching of the luxurious 950-foot White Star *Majestic*, the largest liner afloat, marked a new era in ship-building. Likewise this episode indicated the birth of a new and surprising era in the possibilities of radio equipment aboard the modern type of trans-Atlantic vessel.

The *Majestic* carries a 1½ kw. C. W. transmitter; a 1½ kw. rotary gap spark set and a 1 kw. quench gap transmitter that acts as an emergency outfit. The one-wire antenna is more than 300 ft. long and 85 ft. above the water.

Plate voltage for the C. W. set is supplied from a motor generator in an adjoining room, which also contains the m.g. set for the spark transmitter. Filament current comes from the main lighting circuit, a step-down transformer being used. Communication can be carried on over wavelengths ranging from 1800 to 3000 meters.

The equipment includes two receiving sets—one long wave and the other for short wave work. The large receiver tunes anywhere from 200 to 20,000 meters and is used in conjunction with a detector and six-stage amplifier. The other set is known as a "piano" tuner, because of the fact that inductance is either added or subtracted by simply pressing keys, as on a modern piano. Provisions have been made so that the six-stage amplifier may also be used in conjunction with this outfit. English tubes are employed, using 20-30 volts on the plates and 3-6 on the filaments, the current for both being derived from a bank of storage batteries. These batteries can be charged without difficulty, as a charging outfit is part of the equipment of the radio room. This same outfit is used for the upkeep of the storage batteries which operate the small spark set, otherwise known as the emergency transmitter.

The direction finder "loop" consists of two wires, at right angles, about thirty feet from the top of the radio cabin. These two wires are arranged to represent two "loops"—one a fore-and-aft loop and the other an athwartship loop. With such a scheme, bearings may be taken from two coast stations, instead of one. The receiver used with the radio compass is a detector and five-stage amplifier.

On the last voyage of the *Majestic*, radio messages were exchanged with

Continued on page 74

1½ K. W. Tube Transmitter on S. S. "Majestic" showing Operator Brunt using "D. F." Radio Compass

QUERIES & REPLIES ON C.W. PRACTICE

BY

Gerald M. Best

TECHNICAL ADVISOR

Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25 cents per question should be forwarded when personal answer by mail is wanted.

Errata Notice: In May RADIO, page 37, Question 1 should refer to Fig. 1 on page 27, instead of page 37. The question accompanying Fig. 1 on page 37 was omitted, and is given herewith:

Please publish a circuit for a two stage audio frequency amplifier, using choke coils instead of transformers. Will 500 or 1000 ohm coils from polarized telephone ringers be satisfactory for choke coils? R. E. H., San Francisco, Calif.

The circuit you wish is shown in Fig. 4. The coils you mention will probably be of sufficient inductance to serve the purpose, but a couple of Wayne bell ringing transformers will perhaps be the best. The primary winding of a Wayne transformer has an inductance of 25 henrys, and you can leave the secondary winding open, as its inductance is too small to be of any use.

Please correct my circuit diagram, and inform me if it is an efficient type of receiver? C. T. M., Anita, Iowa.

The corrected diagram is shown in Fig. 1. For long and short waves, you should have some means of adjusting the primary circuit, unless you wish to

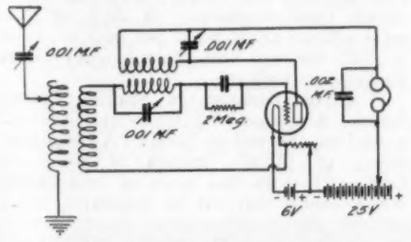


Fig. 1

cover only a very short band of wavelengths. A tapped variocoupler will do the work very well.

Could a wet battery similar to that described on page 19 of April RADIO be made to yield a higher voltage by using a stronger solution of sal-ammoniac and a larger zinc element? Would it give as large an ampere hour capacity? F. E. R., Burlingame, Calif.

A very strong solution of sal-ammoniac might give a few hundredths of a volt increase in potential, but not enough to be of any consequence. The only way you can raise the voltage is to increase the number of cells, placing them in series. You would thus need four cells for six volts. A battery of this sort, however, will give only a very small amount of current, and cannot be used for lighting the filaments of transmitting tubes, or even more than one of the new .25 ampere tubes now in use.

Please explain how to eliminate a ringing sound which occurs in my receiving set whenever I tune the condensers or adjust the filament rheostat. Please publish a circuit for one stage of radio-frequency amplification, detector and one-stage audio-frequency amplification, using a single tube in a reflex circuit. W. L. L., Colfax, Calif.

The only explanation that occurs to me is that you either have a defective tube, in which the elements vibrate easily, or that you have poor contacts on the movable elements of your air condensers and filament rheostat. Investigate the contacts on all moving parts, in your set, and you may locate the source of trouble in a dirty contact. Try substituting a new tube, if you have one available. The reflex circuit you wish was published in May RADIO, on Page 27, Fig. 2.

I have a 5-watt a.c. C. W. transmitter. Why does the tone change in the phones, and the filament flicker occasionally? I think that the 110 volts flickers also. C. S. P., Los Angeles, Calif.

From your meager description of your trouble, I would say that you had a loose contact in your filament circuit. Try cleaning the prongs of your vacuum tube socket, and the springs in your filament rheostat. Also the terminals on the vacuum tube itself. If the 110 volt supply is unsteady, there is no way for you to remedy the trouble except to complain to the power company. Perhaps you are feeding back energy into the power line through your transformer, in which case you probably have no radio-frequency choke in the lead from the power transformer to the plate of the tube. This choke should be at least 3 millihenries inductance, and may be made by winding 200 turns of wire on a 3-inch tube, or obtaining a 250-turn honeycomb or Giblin type coil.

Using a two-circuit receiving set, what distance can I get with a WT-501 peanut tube? As much as with a WD-11? Are either as efficient as C-301-A detectors? Referring to the article on page 19 of April RADIO, can this battery be increased to six volts by increasing zinc electrodes? R. W. F., Glendale, Calif.

The C-301-A tube should give a greater power output than either of the peanut tubes, but requires, of course, a greater filament voltage and filament power consumption, as well as plate current. Either of the peanut tubes should give you good results, within the limitations of a peanut type tube. For the answer to your last question, see answer to F. E. R. on this page.

Please publish a circuit for one-stage radio, detector and one stage of audio-frequency amplification, for use with or without loop antenna. Please give dimensions of loop, and best make of required parts for the set. T. J. J., San Francisco.

The circuit you wish is shown in Fig. 2. A loop for broadcast work should be at least two feet square, and contain 12 turns of wire, stranded if the loop is to be portable. It is against the policy of this department to specifically recommend any one make of apparatus.

Who holds the world's record for radiophone receiving with detector tube only? I have received 3300 miles, and wonder how close this is to the world's record. F. A. M., Puente, Calif.

That would be about as easy to answer as to decide who holds the world's non-stop dance record. It is not uncommon to hear of stations having been heard over a distance of 3000 miles and more, with a single tube, and I would hesitate to start an argument by making a definite statement as to what the record really is.

Please publish a circuit for a regenerative tuner consisting of two variable condensers, variocoupler and two variometers, with two stages of radio-frequency amplification, detector and two stages of audio-frequency amplification. F. M. M., Clinton, Mo.

If you have a regenerative receiver with variometers, you cannot very well use radio frequency amplification without the sacrifice of regeneration, and if that were the case, another type of tuning element would be preferable. Fig. 2 on page 39 of March RADIO shows two stages of radio-frequency, detector and two stages of audio-frequency amplification, using honeycomb or Giblin-Remler coils, and should be about what you want. If you wish the variometer circuit, however, I will be pleased to send it to you.

How can I tell the difference between C. W. and spark signals? How may the output in watts of a transmitting set be determined? What is the output in watts of the radiophone described on page 11 of March RADIO? E. S. S., San Francisco, Calif.

Spark signals may be heard on any type of receiving set, either vacuum tube

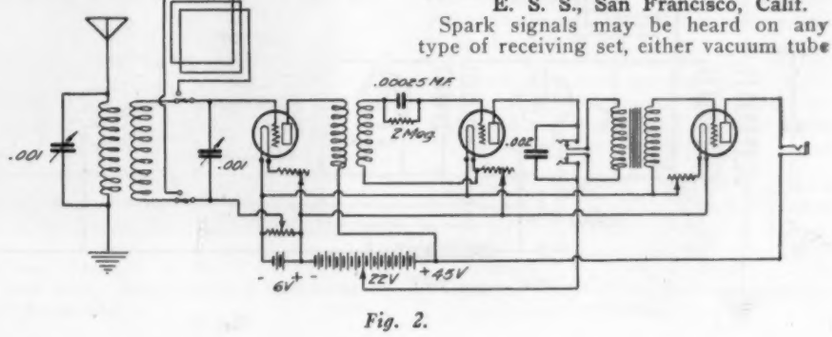


Fig. 2.

or crystal, and may be usually identified by the fact that the tone never changes, no matter what the adjustment of the set. A C. W. signal requires the presence of a local oscillator, either by means of a tickler with the detector tube, or a separate heterodyne oscillator, and the tone is easily changed by a slight adjustment of the tuned circuit. Transmitting tubes are always rated in watts output, and if the tubes are operated at their proper plate voltages, you may calculate the watts output by multiplying the sum of the tubes in the circuit times the watts output of each. The output in watts of the set described in March RADIO is about one tenth to one quarter of a watt.

Please publish a circuit of a 2 stage audio frequency amplifier to be used with "An Efficient Broadcast Receiver" published on page 30 of March RADIO.
J. H., Jasper, Mich.

A circuit for the amplifier you wish is shown in Fig. 3.

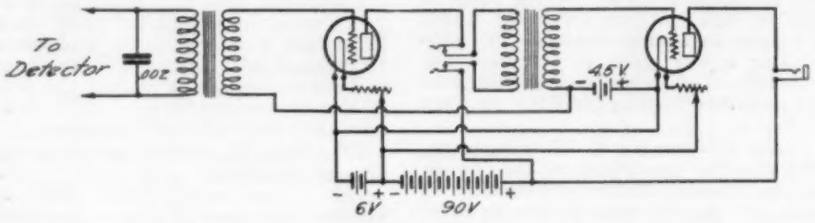


Fig. 3.

Kindly publish the diagram of a two tube reflex circuit. Are there any stations sending out code for amateur practice, and if so, where are they located?
N. F. M., Claresholm, Alberta.

On page 27 of May RADIO you will find a complete story on the reflex circuit, with three diagrams for the different types of circuits. Station KLX, the Oakland Tribune, Oakland, Calif., sends code between 6:45 and 7 p. m. daily except Sunday on 360 meters.

Please publish a circuit which will add one stage of radio frequency amplification and 2 stages of audio frequency amplification to the receiver described by "Six Zee Jay" in March RADIO.
W. M., Corcoran, Calif.

Adding one stage of radio frequency amplification to the set you mention would be of very little help, and better results would be obtained by using a different type of tuned circuit, such as is shown in Fig. 2 on page 39 of March RADIO. The two stage A. F. amplifier is shown in Fig. 3.

Please publish a circuit showing detector and 2 stage audio frequency amplifier, using peanut tubes, with variometer and variocoupler tuning.
F. A. P., San Francisco, Calif.

This circuit is illustrated on the Question and Answer page of February RADIO. If you do not have a copy of this issue I will be pleased to send you the circuit.

Please give me a circuit diagram for a receiver that will eliminate the interference I am now experiencing with my present regenerative receiver.
C. A. W., Cleveland, Ohio.

A very selective and long range receiver is shown schematically in Fig. 2 on page 39 of March RADIO. It is rather difficult to prescribe a particular receiver for you unless I am familiar with all the details of your installation.

Please give me a circuit for two stages of radio frequency amplification, detector and two stages of audio frequency amplification. Is it correct to line the back of the panel with tinfoil? Can you give me a diagram for a wave trap?
F. K., Chicago, Ill.

A circuit using the above arrangement is shown in Fig. 2 on page 29 of March RADIO. It will greatly aid in making your set free from capacity effects if you line the back of the panel with either tinfoil or thin sheet copper, and ground this shield. A diagram for a wave trap is shown in Fig. 5 of May RADIO.

Please give me a circuit for a triple honeycomb tuner, with detector and two stage audio frequency amplifier.
J. H. G., Daly City, Calif.

This circuit is shown in detail in Fig. 4 page 40, April RADIO, with an additional power stage for operating a loud speaker at a high volume.

Please furnish me with data on the construction of a C. W. transformer to step up 110 volts 60 cycle a.c. to 500 volts. **C. S. G., Venice, Calif.**

I presume that you wish this transformer for only one tube, and hence I am giving you the winding data for a 500 volt secondary. The core for the windings I am specifying, I assume to be of soft iron. If you have silicon steel available, you should cut the cross sectional area of the core in half. On a core having cross sectional dimensions of 1½x1½ inches, wind a primary of 365 turns of No. 14 or No. 16 B. & S. D. C. C. wire. For the secondary, wind 1650 turns of No. 26 or No. 28 black enameled or cotton covered wire. This secondary may be wound over the primary winding, or on the other leg of the core, if desired. The core should be in the form of a square, the inside dimensions being four inches each way.

Please publish the sizes of inductances for use with C. W. circuit given in Fig. 5 on page 40, April RADIO. The antenna coil will be wound on a 4-inch tube and the grid coil on a 3-inch tube.
J. A. C., San Diego, Calif.

For 200 meters, the antenna coil should be 40 turns of No. 12 B. & S. wire, and the grid coil should be 25 turns of No. 16 B. & S. wire, with taps at the 15th and 20th turns for fine adjustment.

Please publish a circuit for two stages of radio, detector and two stages of audio frequency amplification, using peanut tubes. I would like to use honeycomb coils. **P. K. M., Fair Oaks, Calif.**

This circuit is shown in Fig. 4 on this page.

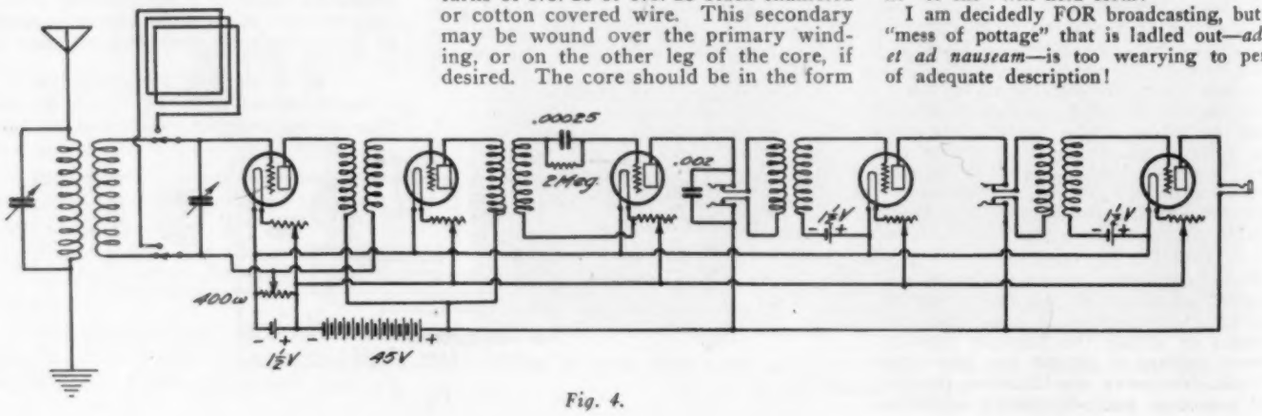


Fig. 4.

WOULD IT NOT BE WONDERFUL IF.....?

By 6XAD-6ZW

Would it not be wonderful:

If 80% of the speakers on the air could hear themselves as others hear them?

If 95% of the "artists" could listen to themselves—at some miles' range? (distance would *not* lend enchantment!)

If 99.9% of the propagandists for this—and that—and t'other—and with which the inoffensive ether is nightly laden—were eliminated?

If announcers at broadcasting stations would cease the boosting of their own prowess — and of their particular station, stating that it has been heard 50,000 leagues under the sea, etc.! WHO gives a hoot—anyway?

If "veterans," "retired Army officers," retired Navy" ditto, unheard-of "authors" of both genders, and "poets", would-be "musicians" (and *has*-beens!) if ALL of these were allotted ONE *night per year* in which to "fill the air with horrid sounds"—as Shakespeare hath it?

If terrific outbursts in Spanish, French, Italian, Arapahoe languages—were *non est*?

And so on—and so forth! A long—long string of "IF's".."friends of the radio land" (!) — in this chaos of broadcasting which—could they all be registered would surprise the madly-zealous perpetrators of the AVERAGE BROADCAST BOREDOM!

Personally—speaking—the instant that I hear some such thing as this: "Friends of radio land, we have with us tonight a distinguished citizen who has———" (done some tiresome thing, or another, and fancies himself greatly for it!)—"he will favor you with a few words. Mr. or Captain—or Colonel—or Mayor Blank."

Then and there is MY cue to shut off my amplifier tubes, light a cigarette and have a small wager with myself as to how long he—or she—will hold forth?

I am decidedly FOR broadcasting, but the "mess of pottage" that is ladled out—*ad lib et ad nauseam*—is too wearying to permit of adequate description!

NEWS OF THE BROADCASTERS

"BROADCASTING"
A Drama of the Night
(In one Wave)
By EARL ENNIS

Dramatis Personae: First Voice; Second Voice; Peeved Soprano; Sore Baritone; Wrathy Tenor; Generator Hum; Static.

Time: Evening. Place: Space. Setting: Ears, antennae, receiving loud speakers, etc.

Generator Hum—Um . . . . ploop . . . . wheek . . . um-m-m-m-m . . . scrawk . . . oing . . . oing . . . oing m-m-m-m-m . . .

First Voice—Hey Joe! Dja get them fuses . . . . . ?

Second Voice—R-r-r- . . . m-m . . . fff!

First Voice—Whazzat?

Second Voice—I SAID NAW. SMatter 'th y'r EARS yuh rummy? We wont need 'em.

First Voice—Th'ell we wont! Th'way she's been shootin' . . . . . .

Second Voice—Well, don't feed her up so high. Y'aint workin' Europe y'know.

First Voice—Who's workin' Europe? We aint.

My GAD! Just as happy as tho he had good sense. Dja try out the circuit to th' control room?

First Voice—She's a'ri' Working' like a duck this mornin'. That bird they had singin' in there nearly blew a tube when he hit them . . . . What's that?

Second Voice—Guess it's them opery stars knockin' for in. Better lead 'em down to the gas room right away. It's time to shoot. (Door bangs.)

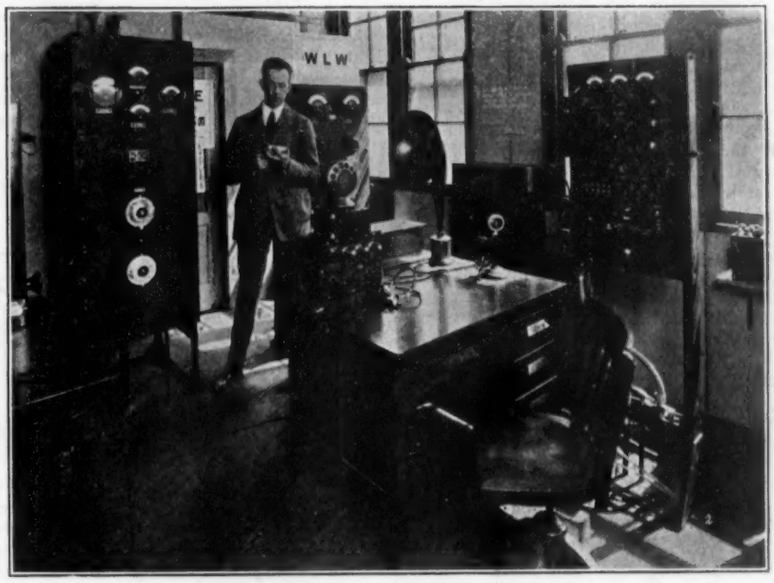
Static—Ar-r-awk . . . . areek . . . shush . . . shush . . cra-a-a-ak . . . . sh-sh-sh . . .

First Voice— . . . . ri' in this way ladies and gents. . This is the control room . . . It's quite a distance away from the operating room because we find . . .

Sore Baritone—Gor gosh sake! What a cold, cheerless place. What is that stuff hanging on the walls?

First Voice— . . . that singers can sing better while they are singing if they sing . . . .

Peeved Soprano— . . . I know my voice is going to be rotten tonight. A-le-lay-oo--eek! (coughs) I knew it. My word, what a jail . . . .



Powel Crosley, Jr., President of the Crosley Manufacturing Company, dedicating the new 500 watt Western Electric radio broadcasting equipment at station WLW, Cincinnati

Second Voice—Gosh! . Eight-fifteen. We'd ought to been goin' ten minutes . . . .

Wrathy Tenor—La-la-la- . . . . . This is a rotten place to sing. Smell the varnish . . .

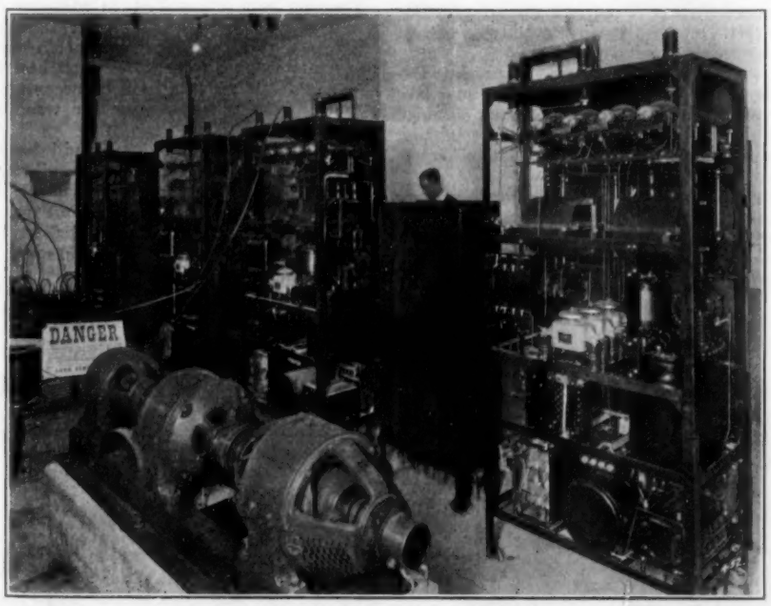
Accompanist—Will you look at that piano. WILL you LOOK at that PIANO! (screams) Heavens! I simply cannot play on a thing like that. I simply . . .

Peeved Soprano — A-la-ley-ee-oo . . . . I never was in such a cold place in my life. It's like the Alps. A-la-ley-ee-oo! Makes me want to yodle . . . .

Sore Baritone—Choke it. (To accompanist) Gimme middle F. (Piano sounds) Ah-la-la! Good Lord! What a harpischord. I'll bet Noah . . .

First Voice—All right gents and ladies. If you're all set, I slip me partner the high sign. There's 50,000 persons listening . . . .

Wrathy Tenor—Yeah . . . and we're singin' to 'em for nothing.



Interior View of New Broadcast Station Erected and Operated by Radio Corporation of America at Aeolian Hall on 42nd Street, New York City. Simultaneous Broadcasting on Two Wavelengths will be possible.

First Voice—When the lights come on in this room, that means the wave is on the air, and you mustn't speak above a whisper, or else . . .

Peeved Soprano—Wave on the air? What's waving? Why shouldn't we speak above . . . ?

Sore Baritone—Lay off Maggie and do what the man says. This aint back-stage yuh know. I know it's hard to keep your face shut, but . . . .

First Voice—All set, everybody?

Accompanist—My word—what an instrument . . . . (strikes keys - clang, clang, clang) Anvil chorus, any key, any place. My word, whata . . . .

First Voice—All set? All right Joe . . . . .

Second Voice—Hey—that wave's been on all the time . . . .

First Voice—It's what? Oh, my gosh! Say folks . . . . . sh-sh-sh- . . . everybody. Listen . . .

Wrathy Tenor—La-la-la! Che mio pocohontas, del fuego con allegro susutenato ravioli . .

First Voice—Hey guy—lay off, will yuh? They're gettin' it outside. Wait 'til I give you the high-sign. There now . . . get up a little closer to the microphone . . .

Peeved Soprano—Do I have to sing into that . . . hole? I won't do it. I . . . .

First Voice—Little farther back for you . . . there . . .your voice being heavier . . .

Sore Baritone—This is a helluvan arrangement. I always stand . . . .

Wrathy Tenor—Well I'll be blamed if you are going to drownd me out . . . Look here!

First Voice—All set . . . sh-sh- . . . keep your voices down, will yuh! Wait 'til I tell you to go ahead. (Rings bell) Hello - Joe - all O. K. Let 'er go.

Second Voice—Well for the love of Pete . . . have them guys got paralasis or what?

First Voice — They've got what. Go ahead and cut the speech. Give us the juice. All right folks; Here comes the light . . . . . ready now . . .

Second Voice—Hello, hello, hello! This is KXYZ calling - KXYZ! The first number on the program tonight will be . . . .

Static—Arrawk . . . . screek . . . . squish . . . . squish . . . . knick . . . knick . . . . ik

Generator Hum—Ho-hum-m-m-m-m-m-m-m-!

(Curtain)

LETTERS TO THE EDITOR

Observing the Pacific Plan

Sir: This office will very much appreciate your publishing in the next issue of RADIO that it has come to the attention of this office that many amateurs of the Sixth Radio District are apparently unintentionally not abiding by the Pacific Plan.

For the benefit of better radio, the following is again brought to the attention of the public: "Pure C. W. transmission only should be employed during the period between 8:00 and 10:00 P. M., i. e., without any apparent ripple caused by commutation or the use of A. C. on the plate, or filament of tubes. In other words, where necessary, a properly designed filter should be employed so as to eliminate any modulation of the pure C. W."

During the quiet period between 7:30 and 8:00 P. M., there should be no broadcasting or amateur transmission of any kind throughout the Sixth Radio District.

Yours,
BERNARD H. LINDEN,
Acting Radio Inspector.
San Francisco, Calif.

Getting the Concerts

Sir: When the broadcasting boom commenced I had a loose-coupler receiver which did not prove satisfactory. I then tried both single-circuit and three-circuit factory-built sets. Failing to obtain desired results, I subsequently experimented with almost every kind of inductance and hookup, including honeycomb and spiderweb coils, Reinartz and various other circuits. I have used five different makes of variable condensers—multiplate, parallel two-plate and book-type.

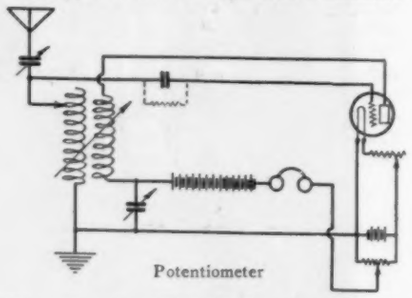
The tuning unit I have always considered the most important part of a concert set because, while range is desirable, selectivity is absolutely essential. Now, after a year of shopping, winding and wiring, I have finally secured a tuner which comes so close to perfection that I want other fans to know about. The inductance is a Capitol All-Wave Coupler, which is bank-wound and has a range of 150 to 3000 meters. It is very compact and combines both range and selectivity. In series with antenna I use a Microdenser, which is by all odds the most efficient variable condenser on the market today. It tunes extremely close, stays put, has no hand capacity, and is both moisture and dust proof. With these two little instruments I am able to consistently bring in distant stations with wonderful strength and clarity. One Sunday evening recently, when practically every receiver in this district was smothered by static, and CFCA, Toronto, had to discontinue broadcasting, I was able to get WGY, Schenectady, 450 miles distant, using the above tuner and one tube. The broadcast, which was a church service at Albany, came in loud and clear.

My advice to amateurs is that they assemble their own sets, using only standard parts. In this way they gain knowledge which invariably proves valuable later on. Factory-built sets are all right so long as they work, but when anything goes wrong with them, repairs are difficult. Sometimes their owners do not even know their hookup, and quite often the defective part is inaccessible to anyone but an expert. W. T. CLARKE.
Lion's Head, Ontario, Can.

Improving the Mundt Hook-Up

Sir: Those using the circuit described by Carlos S. Mundt in Feb. RADIO will by this time have saved up a few dollars or so, I am sure. This can be put to good purpose, by using it to improve the receiving set. By adding the potentiometer shown in the hookup, the efficiency of the circuit is increased 25 per cent as it allows you to adjust the tone and quality. This is especially handy on ac C. W. signals, as it can eliminate the hoarse 60 cycle note.

I have had trouble in using the maximum regeneration in the hookup, as it causes a loud hissing in the phones when you push the tube a little. This is not caused by the *B* battery, as I have always used a standard



22½ volt cell. This hissing is especially noticeable after adding a step or two of audio frequency amplification. This can be done away with by using a vernier rheostat or rotating the tickler coil. Both of these methods cause a loss of signal strength to a small extent. By adding the potentiometer this can be avoided, for by adjusting the potentiometer the hissing can be stopped and at the same time there is no loss of signal strength. Also by admitting the grid leak I obtain just as good, or better, results.

Yours,
JACK WARD,
Berkeley, Calif. Radio 6ckc.

Adding R. F. to Gibbons Hook-Up

Sir: Being one of many admirers of your magazine, I am anxious to have you hear of my experience with the hookup originally designed by M. W. Sterns, and called by you the "Gibbons hookup."

I have used this for several years to very good advantage, but realize several inherent objectionable features such as reradiation. Using a good hard tube you will be surprised at the radiation obtainable, using a microphone in the ground circuit or a key around the grid leak. Located as I am in a congested district, I realized my set probably disturbed many listeners exactly as their "rock crushers" annoyed me.

I therefore built a one-step radio frequency amplifier for the set, chiefly to eliminate reradiating signals. The results obtained were so very good that I wouldn't be without it, and strongly recommend that all users profit by my experience.

Much better results are obtained on long distance receiving, and with the additional high frequency amplification the filament control is very much less critical. The radio frequency tube is lit to max. at all times so that a snap switch is used for this tube in place of a rheostat.

I suggest for the radio frequency transformer a variometer for the primary and a tapped coil for the secondary. A device similar to the New York Coil Company's 3-circuit tuner or the tuner suggested by 6ZJ in your March issue.

If the outfit is required for "broadcasting" only, this coil of course need not have any taps. The primary circuit need not be tuned sharply. Therefore to reduce controls, make a bank-wound coil of 50 turns with a tap at the 50th, 40th, 30th and 20th turns. One of these taps will suit almost any antenna, and once connected need never be changed.

The plate circuit inductance tuning is not critical at all, so that this really does not increase the number of controls and does make a very cheap and most effective addition to an already marvelous outfit.

In case you see fit to publish this I would be very glad to hear from your readers what they think of this job.

Yours,
J. R. BALSLEY.
Ridley Park, Pa.

Magnetic Rectifier

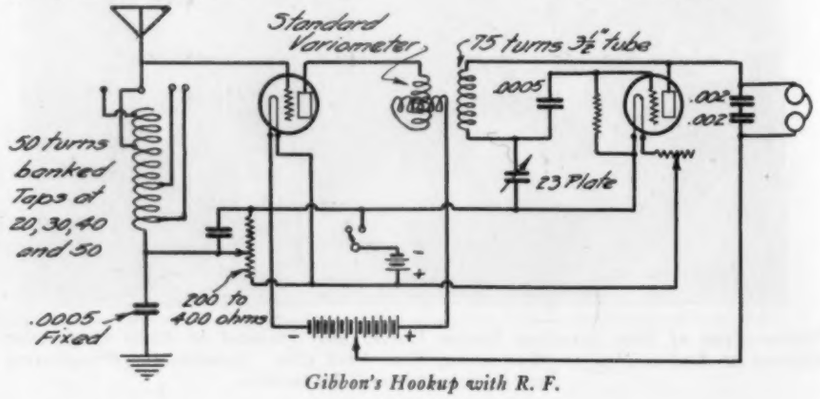
Sir: I received a letter recently saying that trouble was experienced with the magnetic rectifier described in the April issue of RADIO. Perhaps one or two others are experiencing a little difficulty. These notes should correct or forestall such difficulties as might arise.

Be very careful that the alternating flux in the core has no influence on the field of the permanent magnet. That is, see that no iron is in any way in contact with the core and the permanent magnet at the same time.

Care and patience must be exercised in getting the correct initial brush or contact setting. If the contacts are too close the battery may even discharge. High values of current and intense heating of the points may result. If the contacts are too far apart, little or no rectification will be obtained because of mechanical inertia lag. Somewhere between, then, there is a setting that is just right, maximum rectification with minimum heating. This is only found by careful adjustment with the aid of an ammeter in the battery circuit. A little closer setting will give a higher charging rate, but do not raise the rate so high that the contacts become too hot. A little resetting will be necessary from time to time to compensate for wear of the contacts.

The permanent magnet should be strong enough to cause the armature to vibrate vigorously, and the air gap between pole pieces large enough to prevent the armature being drawn over to a pole and held there. This would cause the battery to discharge.

Continued on page 76



Gibbon's Hookup with R. F.

WITH THE AMATEUR OPERATORS

20M, AMERICA'S BEST ALL-AROUND AMATEUR STATION

The highest honor in amateur radio, the Hoover cup of the American Radio Relay League, will be awarded this year to station 20M operated by Frederick B. Ostman of Ridgewood, N. J. Announcement of the award has been made at the League headquarters in Hartford, Conn., by a committee of three judges selected by Hiram Percy Maxim, president.

The cup, which is awarded annually by the U. S. Department of Commerce through Secretary Hoover, is given to the best all-around radio station, the major part of the equipment of which is home-made.

Mr. Hoover desires that the cup be awarded primarily for the best amateur radio equipment in most part constructed by the amateur himself. This is typical of Mr. Hoover, who is an engineer and realizes that the greatest benefits are derived when initiative and individual effort in design and construction are encouraged.

Antenna at 20M.

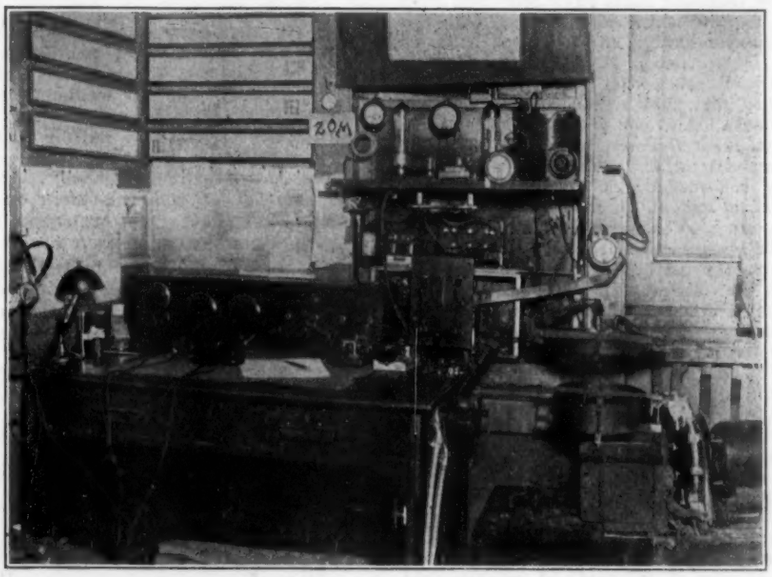
Important factors in its selection are ingenuity in design, construction and arrangement, efficiency, consistent transmitting range, obedience to regulations, amount of traffic handled, and the accuracy and completeness of the station log.

In making the award, two other stations were given special consideration, 2FZ, operated by F. Frimmerman of 740 Prospect Ave., New York City, and 5ZA, operated by Louis Falconi, Roswell, N. J., winner of the cup last year.

Radio Station 20M, located at 180 Broad St., Ridgewood, N. J., operates on spark and CW. It is owned by Frederick B. Ostman, Prescott Smith and Walter Ostman.

The efficiency of the transmitter can best be gathered by the fact of the many long distances at which signals have been reported and stations worked. A constant transmitting range of approximately 1400 miles—half way across the continent, is nightly effected.

Reception of 20M signals—either spark or CW—have been reported in every state in the Union except Colorado, New Mexico, Nevada, Utah, Montana, Arizona and Idaho, a total of 41 states, also in England, Porto Rico, Cuba, Canada, South America, Canal Zone and off the Pacific and Atlantic coasts.



Radio Station 20M.

Communication has been effected with every state east of the Mississippi River.

To get an idea of the receiver range—signals have been reecived from all of the large broadcasting stations as far west as the Pacific Coast. Amateurs from every U. S. District, Canada, Porto Rico and Hawaii have been copied.

Operators at the station pay strict adherence to the U. S. Radio communication laws, and have been co-operating faithfully with local arrangements—designed to give the broadcast listeners quiet hour between 7:30 and 10:30 p. m. each evening.

Operators of the station display excellent quality of judgment in operating. Records show station 20M handled 3426 amateur radiograms during 1922—more than any other station in the country during this period. A complete log of daily entries, containing lists of stations heard and worked throughout the year has been kept.

The operators of the station worked untiringly for the advancement of amateur radio, assisting in many ways the local club and national organizations devoted to the amateur.

Mr. F. B. Ostman, director of the station, is the executive assistant Atlantic Division, Northern Section, American Radio Relay League, which covers the states of New York and New Jersey. Monthly traffic reports from every amateur transmitter in these states goes through his hands, total messages averaging between 12,000 and 20,000 per month for this section.

Description of Apparatus

Transmitting power supply is furnished by the 110 volt 60 cycle AC mains. A special 3 kw. transformer on the pole allows for over load with a 15 ampere meter in the house. No. 8 wire leads from the meter to the switch board wiring around the set is in B X cable.

Primary and rotary gap power mains are protected with two large 5 kw. Dubilier kick back preventors. The high voltage transformer is a 1 kw. United Wireless transformer with a secondary giving 30,000 volts. The condensers in use are two special Dubiliers of .014 mfd. capacity in series connection. Parallel to these is a large section of plate glass condenser immersed in oil with an approximate capacity of .009 mfd. Primary of the oscillation transformer is of 3-inch brass ribbon 1¼ turns used for 200 meters.

The gap is a Grebe synchronous 8 point rotor 10½ inches in diameter. This motor is a Crocker Wheeler 220 volt ¼hp. 1800 r.p.m. 220 volts is furnished by a step-up transformer.

Closed circuit leads are all of 2-inch copper braid and very short. The secondary consists of 1-inch brass ribbon, 5 turns being used for 200 meters. The oscillation transformer is constructed of ½-inch bakelite supports, hinged pancake type; normal coupling is 6 inches.

Antenna transfer switch is an angle triple pole switch on ½-inch bakelite. This breaks the antenna circuit for transmitting and receiving. The transmitting grounds run direct from the oscillation transformer secondary.

Rotary gap and power is controlled by two SPST switches along side of the operating table.

Radiation as indicated by a Weston T. C. ammeter on normal coupling. Full power is

Receiving Set at 20M.

6½ to 7 amperes. A decreement of 1.5 was given after a check by a U. S. Government Inspector.

C.W. Transmitter

The following tubes have been used from time to time while experimenting with this type of transmitter, one to four U V202 (5 watt tubes), two U V202 and two Western Electric E tubes. (It was with this combination that 20M signals were reported in England). Also one to two U V203 and a ¼ kw. input DeForest tube.

Plate current for these tubes is furnished by a homemade high voltage transformer wound on an old Thordarson ¾ kw. spark transformer. Voltages from 750 to 1600 volts can be obtained also from 500 volt dc. generator which has been belted up and will deliver 750 volts dc. Filament current is furnished by a 200 watt Acme filament lighting transformer which has been rewound to give the following voltages with a center tap 6, 12, 18, and 24 volts and will pass enough current for ¼ kw. tubes. This voltage is regulated by a homemade rheostat in the primary circuit of the transformer with a slider adjustment. Two .5 mil henry reactors and filter condensers of from 1 to 3 mfd. are used to smooth out the ripple for pure direct current. 1 L 200 H. C. coil is used for a radio frequency choke. Radio Corporation sockets are used. Separate grid condensers are used on each tube of .002 mfd. A separate grid leak of 2500 to 5000 ohms resistance is also used. The inductance is homemade, a large tube 7 inches in diameter wound with 38 turns of No. 12 wire. The Hartley circuit is used with a tuned ground and counterpoise.

Experiments are now being made with a 40 jar chemical rectifier to handle 1000 volts dc. for the plates of the 50 watt tubes and the use of the synchronous spark gap for a synchronous rectifier handling the voltage from the secondary windings of the spark transformer in parallel for use on a 250 watt U V204 ¼ kw. tube.

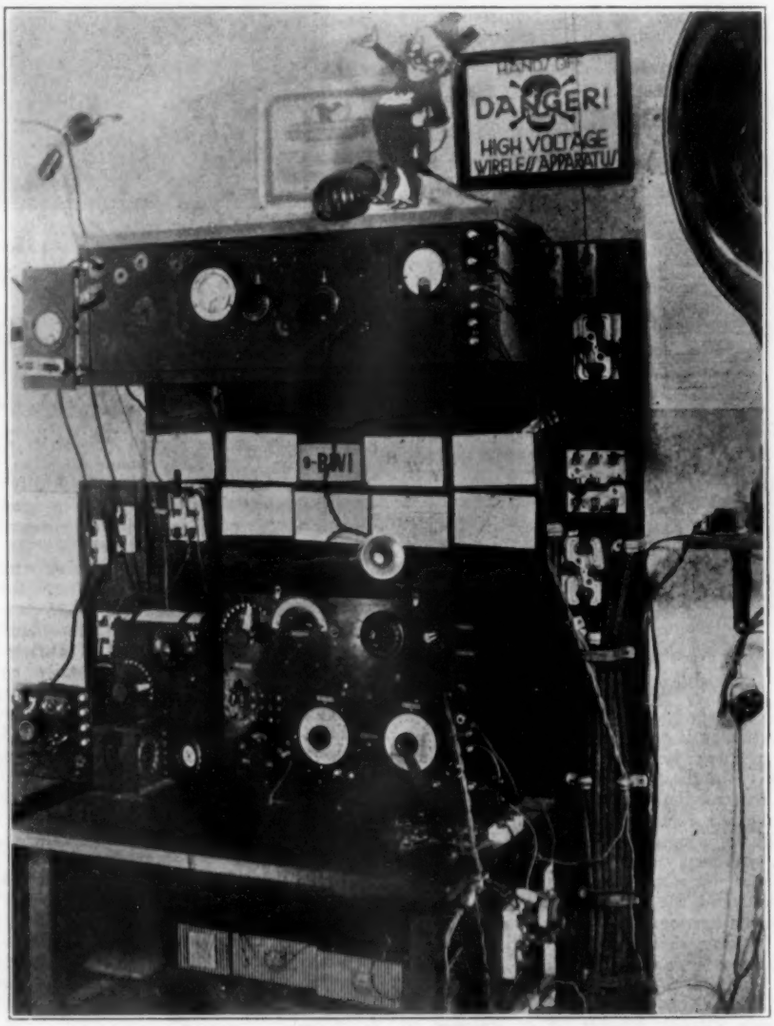
Receiver

The receiver, which has done exceptional long distance work on all waves which it covers, was designed and built by F. B. and W. H. Ostman and embodies some excellent workmanship in its construction.

It is a three circuit tuner with a detector and three stages of audio frequency amplification. A novel scheme is used for improving the results obtained from a short wave regenerator of the type using variometers for both grid and plate tuning. A four circuit three position anti-capacity switch is mounted on the rear of each variometer. These switches perform the following feats, when thrown to one side (left) they connect the rotor and stator coils of each variometer in parallel, giving a wavelength range of 130 to 295 meters with better control and better signal strength than normal because losses are less, resistance less and the full 180 degree rotation available over amateur waves only. Thrown upright these switches connect the windings of each variometer in series as usual with a range of 180 to 550 meters and when switches are thrown to the other side (right) they connect the variometer windings in series and in addition switch small condensers into parallel across them giving a wavelength range of 435 to 1400 meters.

Antenna System

The aerial is a vertical slanting flat top inverted "L" type. Six wires spaced 3 ft. 75 ft. long, 35 and 80 ft. high. The high end spreader is of one inch iron pipe each wire being soldered to this. The bridle is of heavy rope with 10-inch electrose insulators. The lead in is taken from the low end and is a 10-inch cage run directly to the lead-in insulator into the operating room. The low end spreader is of wood, each wire being insulated by a large porcelain ball insulator. The bridle at this end is also of rope with large insulators and is fastened to the peak of the house. The ground system consists of the watermains all connected with heavy jumpers soldered, a well in which was sunk a long length of tin besides well pipe, a cistern in which was put over 50 lbs. of salt. Strips of roofing tin one foot wide and four feet apart run directly underneath the aerial. Each ground lead is of one inch copper ribbon; run directly up to and tuned separately on the secondary of the oscillating transformer. A tuned counterpoise is also used which consists of two wire starting from the station running 150 ft. These wires run 60 ft. past the end of the aerial and are 60 ft. apart at the far end and are connected. When used separately this counterpoise gives a much higher radiation than the ground system. Tuned with the ground system a still higher radiation is had. The natural wavelength period of the antenna is approximately 160 meters.



Radio Station 9BWI

RADIO STATION 9BWI

This station is owned and operated by R. E. Chapman at 115 N. Pearl street, McLeansboro, Ill. It is easily seen that the entire receiver and transmitter was constructed at home. The receiver includes three separate tuners and one tube super. Also a third stage of power amplification is used at times.

The transmitter is a 10 watter, using the British Aircraft circuit. The generator is a small d. c. motor rewound, and delivers 400 volts to the plates. All inductances, chokes, and the filament heating transformer were made at home, using 7½ volts on the filaments. The antenna current is 1.4 amperes, on voice.

The antenna system consists of an 8-wire cage 4 ft. in dia., 65 ft. long and 60-40 ft. high. The lead-in is also cage 2 ft. dia., 8 wires; counterpoise is from 50 ft. long, 50 ft. wide and 8 ft. high. Antenna and counterpoise are all 7x20 cable.

The buzzer has been reported very QSA in Santa Barbara, Cal., Spokane, Wash., and most all of the Western states, and phone signals reported QSA in most of the Central states in a radius of about 600 miles.

NEWS OF THE RADIO OPERATORS

Radio amateurs recently saved the day for William Desmond, film star, and a big company engaged in filming "McGuire of the Mounted," at Universal City. Jack Lawton, head of the location department, paved the way. For the closing scenes of the big Northwest Mounted Police play snow scenes were necessary, and Lawton planned to send the company into Bear Valley, in the Sierras. But storms had washed out telephonic communication. There was no way of reaching the Big Bear Country Club to make reservations.

Lawton hit on the idea of appealing to the wireless amateurs. He approached members of the Los Angeles amateur radio club, and these agreed to attempt to relay his message in.

"Within a few hours," Lawton says, "I had no less than six telephone calls, reporting successful delivery of the message and bringing back an affirmative answer to my request to Jack Betterly at the country club to reserve accommodations for fifteen actors, the director and the cameramen." Thanks to the prompt aid of the radio experimenters several valuable days were saved in filming the play.

Continued on page 76

Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station

By Homer Jaggers, Kahuku, Oahu, T. H.

6jd, 6aw, 6zu, 6beg, 6aag, 7zu, 9ccs de 8yv, 9dvj de 6cu, 8cmi de 6brf, 6mh, 9dwc de 9gt qsa, 6aoi, cq east, 9dvj, de 6iv, 6ahu, de 7ak, 5nz de 6ahu, 9xaq de 6iv, 9ry doubtful, 5go doubtful, 6cay, 6cej de 7sn, 4ek doubtful, 6bic numerous times, 7tq de 6bic, 9mt de 6bvc, 9mt de 9ur doubtful, 7zu very qsa.

By 6BUY, 2732 Prince St., Berkeley, Calif.

C. W.: 2fp, 4eb, 5pf, 5za, 5tj, 5ado, 5vo, 5aec, 5ej, 5zav, 5gg, 5kc, Can. (5ak), 5ct, 5cn, (6bwf), (6bje), (6bqz), (6brs), 6(bod), (6bru), (6aak), (6bjy), (6bjq), (6bun), (6ea), (6bqd), (6aib), (6bh), (6bqk), (6bjg), (6bwq), (6bip), (6ags), (6bqa), (6bah), (6cim), (6cga), (6bea), (6cfm), (6aoi), (6che), (6bqs), (6bri), (6chf), (6bjj), (6cgg), (6bur), (6bhk), (6yc), (6bri), (6atq), (6agu), (6bra), 7sc, 7zk, (7ny), 7bk, 7zu, 7mf, (7tq), (7sy), 7aft, 7arf, 7ot, (7lu), 7bj, 7afs, 7yg, (7aem), 7adp, 7lr, (7li), (7mc), 7nf, (7om), 7ln, (7wx), (7qt), (7na), 7gv, (7wm), (7pf), (7dc), (7aca), (7ge), (7ak), 7afw, (7hj), 7eq, (7nn), (7ro), (7kf), (7nx), (7aic), 7ey, 7hi, 7tt, (7hs), 7ga, 7qn, 7adf, 7dh, 7wk, 7aea, (7wq), (7tn), (7ut), 7my, 7hx, (7sf), 7pj, 7we, (7abb), 7agu, 7abc, (7adc), 7js, 7adq, 7oh, (7adg), 7ej, (7acx), 7wa, (7ahi), 7ng, 7wg, 7zr, 7iy, 7aff, (7vf), (7adp), 8eo, 8ib, 8xe, 8atx, 8boe, 8cdd, 8dfx, 8cfv, 8ue, 9zaf, 9pi, 9bji, 9aps, 9cns, 9bxq, 9ani, 9ami, 9ym, 9axq, 9avz, 9awm, 9dky. 9bey, 9lu, 9asf, 9bm, 9bed, 9bkp, 9bly. 9yw. (9bxm), 9cac, 9aey, 9bjk, 9bvm, 9bvy, 9bzi, 9zn, 9aog, 9ccy, (9anp), 9avu, 9abu, 9dwn, 9brk, 9uu, 9cuo, 9cfy, (9dte), 9aua, 9eea, 9anq, 9duj, 9bp, 9bx, 9yl, 9abc, 9apf, 9dug. Anyone hearing my 10 watts pse qsl crd.

By 5AAH, Ardmore, Oklahoma

1bes, 2jl, 2asp, 3ag, 3bj, 3bvc, 3dh, 3gz, 3jl, 3tj, 3zp, 4bi, 4cq, 4cy, 4dc, 4ea, 4eh, 4gz, 4hh, 4hw, 4me, 4od, 4oi, 4xa, 5's too numerous, 6awt, 6ajd, 6brg, 6cc, (6caj), 6cek, 6ke, 6ku, 6zh, 6zn, 6zz, (6aqp), (7abb), 7afw, 7dh, (7lu), 7pf, 7sc, 7wx, 7zu, 8alb, 8apn, (8bcy), 8bda, 8bdo, 8boz, 8chb, 8cia, 8cjz, 8cmm, 8cpu, 8daj, 8dat, 8er, 8ew, 9's too numerous.
Can.—3bv, 3ko, 4xn, 9bw.

6CHL, Arthur Martini, 3948 26th St., San Francisco, Calif.

All C. W.: Can.—3dh, 4hh, 5cn, 9bx.
4eh, 4km, 4oi (qra?), 4ya, 4yd, 5ec, 5ek, 5kc, 5lu, 5mo, 5nn, 5nz, 5qa, 5uj, 5xa, 5xb, 5za, 5zh, 5acf, 5ado, 5xab, 5xad, 5xaj, 5ak, 5gg, 6's too numerous, (6zz), 7ab, 7ag, 7ak, 7bj, 7dh, 7dp, 7hf, 7hj, 7hm, 7ln, 7lu, 7mc, 7mf, 7na, 7nf, 7nk, 7nr, 7om, 7pj, 7qt, 7rr, 7sc, 7sn, 7ve, (7sc), 7wa, 7wm, 7ya also fone, 7zf, 7zo, 7zu, 7zv, 7abb, 7acx, (7adg), 7ads, 7aea, 7aff, 7afn, 7afw, 7afo, 7agi, 7aic, 7aiu, 7zai, 8im, 8mo, 8bxx, 8caa, 8cyu, 9cv, 9dz, 9nr, 9uh, 9yb, 9aap, 9aau, 9afr, 9aix, 9alg, 9aog, 9asf, 9ayu, 9bik, 9bji, 9bjk, 9brl, 9bsg, 9bsi, 9btt, 9bxm, 9bxq, 9bzi, 9cav, 9cba, 9cbt, 9cdr, 9crx, 9cru, 9cuc, 9cwr, 9dca, 9dhi, 9djm, 9dky, 9dqm, 9dte, 9dvj, 9ekh.
khj, kfi, kjs, kyw, kzn, kdys, kfau, wdap, wgaj, cfcn, kgw. All hearing my C. W. pse qsl crd.

By 6EA, Seefred, 343 So. Fremont Ave., Los Angeles, Calif.

All C. W.: Can. 3ni, Can. 4fn, Can. 4hh, Can. 5ak, Can. 5cn, (Can. 5go), Can. 9bp, Can. 9bx, 5di, 5pb, (5px), 5xb, 5za, 5aec, 5zav, 6ao, 6fy, 6hp, 6iv, 6lu, 6qq, (6yc), 6aak, 6aaj, 6acm, (6alx), 6amz, 6aoc, 6aqw, (6atz), 6awt, (6bfl), (6bgy), 6bhk, 6bmy, 6bnt, (6bon), (6bpf), (6bpl), (6bql), 6bru, (6bsq), 6buy, 6caj, (6ceb), 6cec, 6cee, 6cjj, 7ba, 7bj, 7hf, 7ln, 7nk, 7oh, (7pf), 7sc, (7sf), 7wq, (7wx), 7ya, (7zf), (7zu), (7abb), 7aea, 8zw, (8bxx), 9fv, 9zt, 9abc, 9abu, 9afr, 9amb, (9apf), 9avu, (9avz), (9azg), 9bji, (9bkj), 9btl, 9bto, 9bxm, (9caa), 9cjy, (9cvo), 9dvj, 9eea, kdpv. Would appreciate reports hearing my C. W. over two thousand miles during the Tran-Pacific-Australian tests and other countries.

By 6BUO, 1344 Mariposa Ave., Care Highland Park Sta., Los Angeles, Calif.

3bt, 4bi, 4eb, 4fn, 5ak, 5cy, 5de, 5eg 5gt, 5gj, 5gg, 5go, 5ia, 5iq, 5jt, 5jz, 5kc, 5nn, 5px, 5sk, 5ui, 5uj, 5vo, 5xb, (5za), 5zh, 5adb, 5aec, 5ado, 5xad, 5xaj, 5zat, 5zav, (7ak), 7ba, 7dc, (7dh), 7du, 7em, 7eq, (7ge), 7gf, 7gh, 7gp, 7gs, 7hj, 7hm, 7hs, 7io, 7iw, 7js, (7ln), 7lu, 7lr, 7mf, 7my, 7na, 7nf, 7nk, 7ny, (7oh), 7om, 7pf, 7pj, (7qt), 7ri, 7sc, 7sf, 7tn, (7tq), 7tt, 7ut, 7ve, 7vf, 7wk, 7wm, (7ws), 7wx, 7zf, 7zo, 7zl, 7zn, (7zu), 7zv, 7abb, 7abh, (7acx), 7aca, (7aea), 7adf, 7adg, 7aff, 7afn, 7agu, 7ahc, 7ahw, 7alf, 7afw, 8cf, 8ib, 8qj, 8sp, 8xe, 8boz, 8bzy, 8cfk, 8crb, 8xan, 9bm, 9bv, 9fm, 9kh, 9kp, 9lv, 9bj, 9mc, 9uu, 9yb, 9vm, 9cv, (9wd), 9amb, 9aix, 9ahz, 9apf, 9ape, 9ayu, 9ahf, 9abc, 9anq, 9apw, 9aon, 9aku, 9aau, 9aiy, 9akx, 9aiw, 9auw, 9bvu, (9bji), 9bdz, 9bxq, 9bkw, 9bun, 9bjk, 9bvo, 9bri, 9bsq, 9btp, 9bed, 9bjb, 9bxm, 9bxa, 9cfy, 9ccv, 9cvo, 9ccz, 9cjy, 9ctg, 9cnv, 9cnn, 9cga, 9cjj, (9caa), 9csq, 9ceh, 9cmk, 9dyn, 9dsm, 9drw, 9dez, 9dge, 9dpd, 9dvj, 9dte, 9dhi, 9dgv, 9djb, 9ekx, 9eea, 9ehj, 9xaq.
Can.—4bv, 5cn, 9bx.
Any DX stations hearing 6BUO five-watter pse qsl.

By Allan E. Horning, Anchorage, Alaska

On WD-11 detector and single-circuit tuner.
6ea, 6eb, 6ec, 6cu, 6nx, 6ti, 6tu, 6wm, 6bhk, 6cgw, 7aw, 7nf, 7sc, 7sn, 7ri, 7abb, 7aea.

By 5AKQ, Joshua, Texas

1amp, 2dd, 2awl, 3oe, 3tj, 4bq, 4bi, 5aah, 5ado, 5aa, 5en, 5ek, 5fx, (5io), (5fi), (5tp), (5ajt), 5za, 5xad. 5nn, 5ao, Can. 5cn, 6th, 6jx, 6ku, 6zz, 6zy, 6ame, 7sc, 7lu, 7zh, 8ah, 8cf, 8di, 9en, 9ig, 9ch, 9ahl, 9ma, 9dt, 9di, 9ic, 9eed, 9dhx, 9dht, 9bvt, 9dhq. Anyone hearing my C. W. pse qsl, qrk. Will answer promptly by card.

At 6OV, C. Schomaker, 199 Douglass Street, San Francisco

3co, Can., 4eb, 5qy, 5xa, 5za, 6en, 6er, 6gn, (6fh), 6gt, 6ka, 6od, 6rd, 6wi, 6zs, 6zc, 6aak, 6adl, 6ahp, (6awx), 6bae, 6beg, 6bjq, 6bfw, (6anb), 6ang, 6ajh, 6bun, 7aea, 7ny, 7lu, (7om), (7tq), 7afw, 7zb, 7zu, 7zk, 8cf, 8qk, 8ow, 8br, 8asv, 8cmi, 8zx, 8boz, 9bd, 9cc, 9kp, 9ii, 9pi, 9amb, 9anq, 9aps, 9apw, 9aul, 9bji. Anyone hearing my C. W. pse qsl. All cards answered.

At 1ACC, Framingham, Mass.

All DX CW: 4bt, 4ea, 4el, 4eq, 4eb, 4ft, 4hh, 4iv, 4km, 4lj, 4mb, 4oi, 4xj, 4zc, 5di, 5gg, 5hl, 5js, 5kn, 5mb, 5nz, 5rh, 5tc, 5uo, 5xv, 5xad, 5xab, 5xav, 5zd, 5zav, 5zax, 5zak, 5zg, 5zaba, 5zxz, qra?, 6cu, 6if, 6jd, 6ka, 6aab, 6arb, 6awt, 6bfn, 6boe, 6bun, 6xad, 7ya, 7zo, 7zu, 9of, 9ox, 9pq, 9aap, 9aav, 9abu, 9acd, 9anq, 9aon, 9amt, 9aix, 9amh, 9ase, 9asn, 9ari, 9bcz, 9bch, 9bed, 9bop, 9blg, 9bly, 9bki, 9brc, 9brk, 9bvp, 9bxc, 9cee, 9cbs, 9cd, 9cki, 9ctv, 9cvo, 9dhz, 9dmj, 9dgn, 9doc, 9dpx, 9dsp, 9dwf, 9dyn, 9efc, 9ekf, Canadians: 3de, 3in, 3il, 3ni, 3oh, 3nb, 3si, 4bv, 4co, 9ac, 9aw, 9bm. Will anyone hearing 1aac Ford Coil ICW pse qsl.

At 6BEG, 1150 E. 71st., Los Angeles, California

Detector, 1cmk, 1xq, 3ea, 3ot, 4cg, 5cy, 5di, 5el, 5iq, 5ir, 5jl, 5jz, 5kc, 5ke, (5kp), 5nz, 5pt, (5px), 5rh, 5sf, 5sk, 5ss, 5uk, 5uj, 5vm, 5adb, 5ado, 5aec, 5aib, 5amz, 5anx, 5ars, 5xa, 5xb, 5za voice, 5zh, 5zag, 5zak, 5zax, (5zav), 7ba, (7bj), 7dh, 7du, 7dw, 7gs, 7hj, 7io, 7jw, 7ke, 7ks, 7ln, 7lu, 7mc, 7mf, 7na, (7nf), 7pf, 7qt, 7sc, 7tq, (7vf), 7wr, (7wx), 7abb, (7aea). 7aem, (7afe), (7afn), 7afw, 7ain, 7aiy, 7ajv, 7zl, 7zn, 7zo, 7zu, 7zv, 8bk, 8cf, 8dr, 8ft, 8fu, 8hj, 8ib, 8oe, 8oi, 8sp, 8sw, 8ue, 8wl, 8aem, 8ago, 8alu, 8aqo, 8aqv, 8asl, 8asv, 8axc, 8azd, 8bca, (8bch), 8bda, 8beo, 8bog, 8btv, 8bwl, 8bxa, 8bxh, 8bxk, 8can, 8cdd, 8cei, (8cgj), 8crb, 8cur, 8xe, 8xr, 8yd, 8zw, 8zy, 8zz, 8zaf, 9aa, 9fv, 9gk, 9kp, 9pf, 9ql, (9uh), 9uo, 9ur, 9aaw —spark, 9aap, 9aau, 9abu, 9aey, 9aix, 9aiy, (9aku), 9amb, 9ame, 9amq, 9aou, 9apf, 9api, 9apw, 9arz, 9asf, 9aul, 9auw, (9avu), 9awm, 9ayu, 9aza, 9aze, 9bbf, 9bed, 9bey, 9bik, 9bji, 9bjn, (9bkj), 9bkp, 9bly, 9brh, 9bri, 9brk, 9bsg, 9bto, 9btl, (9bun), 9bvo, 9bxa, 9bxm, 9bxq, 9bxt, 9bzi, 9caa, 9cba, 9ccv, 9cde, 9cdx, 9ceh, 9cfy, (9cjy), (9cki), 9cle, 9cmd, 9cmk, 9cns, 9cpu, 9cuc, 9cwc, 9dca, 9dez, 9dge, 9dhi, 9dka, 9dky, 9dpd, 9dsm, 9dte, 9dtm, 9dvj, 9dwk, 9dyg, 9eea, 9ekf, 9ekh, 9xm, 9yb, 9zt, 9zaf. Can. 3bv, 3gk, 3nb, 3xn, 4bv, (5cn), (5go), 9al, 9bx. 6beg on a 5 watter was logged in Washington, D. C. Any reprts fm Eastern coast stations greatly appreciated and qsl.

At 5ADV, El Paso, Texas

C. W.: 1 ban, 2bqh, 2cka, 3jj, 3ni, 4do, 4eh, 4hh, 4hw, 5aib, 5acf, 5ado, (5aec), 5abh, 5aby, 5aht, 5aar, 5ahd, 5acq, 5aer, (5afq), 5akr, 5be, (5bm), 5cs, 5cy, 5di, 5dq, 5dt, 5ek, (5el), (5en), 5fa, (5 ft), 5ga, 5gj, 5gn, 5hh, 5ho, 5hz, 5ix, 5jf, 5jj, 5jl, (5jt), 5js, (5kc), 5ki, 5ks, 5ke, (5kn), 5lo, 5ma, 5mo, 5mx, 5ml, 5nn, (5nk), 5nh, 5nv, 5nz, (5ok), 5ov, 5pb, (5px), 5pv, (5qi), (5rn), (5rh), (5sr), (5ss), (5sf), 5sp, 5tc, 5uk, 5ug, 5vm, 5vo, 5vy, (5xaj), 5xad, 5xb, 5xv, 5za, (5zh), 5zb, 5zab, 5zae, 5zak, 5zam, 5zas, 5zav, 5zaz, 6aav, 6abk, 6awt, 6aqw, 6ahq, (6anh), (6aqp), (6aag), (6aib), (6ahu), (6ael), (6aoi), 6abx, (6alk), (6awx), (6bqs), (6bsq), 6bjq, (6bka), 6bki, (6bvg), (6brf), (6boe), 6bob, (6bjy), (6bru), 6bpb, 6bod, (6bqk), (6buo), (6bmc), (6bqd), 6bik, 6bvf, 6cgd, 6ccv, 6cfq, (6caj), (6cgw), 6cg, (6cbd), (6cbg), (6cmz), (6eb), (6ec), (6fh), 6gf, (6qw), 6vk, 6vm, 6xad, (6zh), (6zz), 7afw, 7ba, 7dh, 7lu, 7pf, 7ya, 7zl, 7zu, 7zv, 8ab, 8bch, 8bxa, 8cqh, 8hn, 8jy, 8qk, 8rf, 9avc, 9axu, 9aau, (9apf), 9apw, 9ahv, 9amb, 9aap, 9adf, 9atn, 9avz, 9aog, 9aey, 9asf, 9avn, 9aon, 9ayu, 9ari, 9ara, (9ayl), 9afz, 9bbf, 9bzz, 9bxm, 9bxa, 9bkk, (9bjk), 9bji, 9bkc, 9bri, bqf, 9byc, (9bto), 9buq, (9bed), (9bkj), (9bun), (9bxt), 9bkp, 9buc, (9beg), 9bzi, (9brk), 9bhi, 9ctg, 9cvc, 9cfb, 9ccv, (9cfy), 9cwc, 9cvo, 9cjy, 9caa, 9cdr, 9cmk, 9cjj, 9cgk, 9ckp, 9clu, 9ctr, 9cjp, (9cte), (9cki), (9cpu), 9cby, 9cil, 9cjc, 9dky, 9dib, 9dpf, 9dge, 9dsm, 9dpd, 9dsw, (9dgv), 9dwk, 9dzy, 9daw, 9dhi, 9dhs, 9dxn, (9dtm), 9duq, 9dus, 9dof, 9dug, 9dwn, 9dvj, 9ekf, (9ehk), 9ecz, 9ehn, 9fm, 9hk, 9kp, 9il, 9qf, 9mc, (9zt). Spark: 5ag, 5fi, 5yg. Canadian: 4bv, 4cn, 9bx.

At 8AGO, Pittsburgh, Pa.

All C. W. on detector only—(1aw), 1cz, 1dl, 1gv, 1kv, 1my, 1qp, 1rr, 1rv, 1uj, 1xm, 1xu, (1xx), (1yk), 1abb, 1abf, (1adn), 1ajx, 1amb, 1aoj, (1ary), (1atj), 1awb, 1awj, 1bet, 1bfe, 1bgf, (1bkq), 1boe, 1bop, (1boq), (1cac), 1cik, 1ckp, 1cmp, (1cpn), 2fp, 2gi, 2ig, 2ke, (2om), (2rm), 2sq, 2zk, 2acd, 2acz, (2aer), 2afc, 2agb, (2alk), 2anm, 2asi, (2auz), (2awf), 2axf, 2bbb, (2bqb), 2bqh, (2bqu), 2bvh, (2bxp), (2bzv), 2ccd, 2cei, 2cgj, (2cha), (2cim), 2ckk, 2cmc, (2cpa), 2cpd, 2cqz, 2crw, 2cxf, 2cyw, (3ba), 3bg, 3bj, 3bq, 3ca, (3fs), (3gc), (3hd), (3hs), 3iq, 3iw, 3jj, 3km, (3lk), 3mo, 3ni, (3oe), (3ph), 3pz, 3su, 3tj, (3tr), (3vw), 3wf, 3xm, 3xt, 3aao, 3acq, 3acr, 3adq, 3aic, 3ail, (3ais), 3ajj, 3aln, 3alu, (3apr), 3arm, 3aro, 3arp, 3asi, 3asp, (3atb), 3ats, 3auw, (3bds), 3bfc, 3bhl, (3bhv), 3bit, 3blp, 3bmn, 3bss, 3buc, 3buy, 3bvp, 3bwt, (3cah), (3cbu), 3cbz, 3cel, 3cfq, (3xal), 4bd, 4bg, 4bi, 4cy, 4dc, 4dn, 4dt, 4eb, (4eh), 4fa, 4fg, (4ft), 4hw, 4jk, 4jz, 4km, (4ku), (4lj), 4mb, 4nt, 4nv, 4oh, 4pz, 4ya, 5bm, 5bp, 5bw, 5da, 5ek, 5fv, 5ga, 5gn, 5hl, 5js, 5kc, 5pf, 5re, 5sp 5uk, 5vy, 5za, 5zp, 5aah, 5aam, 5ade, 5air, 5xaj, 5zas, 5zat, 5zav, 5zaba (?), 6ka, 6zz, 6xad, 7bh, 7zu, (8's and 9's too numerous, over 300 listed), Canadians: 2cg, 3bv, 3jt, 3tl, (3si).
The correct qra of 8ago is Pittsburgh, Pa., and not Detroit, Mich., as listed in some of the new call books. J. Lanthrop, Detroit is Radio 8agc.

By 6BNT, 225 Willard St., San Francisco

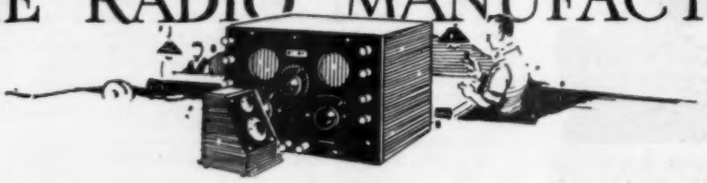
5be, 5di, 5ss, 5za, 5zh, 5ado, 5zav, 6bj, (6eb), 6ec, 6eo, 6fh, (6gf), 6gr, (6iv), 6mh, 6yc, 6zo, 6zt, 6zz, (6zh), 6aag, 6abx, 6ahn, 6alu, 6aoc, (6apw), 6atq, 6avp, 6bah, 6bcl, 6beg, 6beq, 6bjj, 6bjr, 6bmh, (6bmy), (6bod), 6bon, 6bpz, 6bqd, 6bqc, 6bqs, 6bqy, 6brj, 6brf, 6bun, 6buo, 6bum, 6bvf, 6bvg. 6bwb, (6bwd), 6cax, 6cbg, 6cbw, (6cfq), 6cga, 6ckz, 7bh, (7bj), (7dc), 7dh, 7ge, (7hf), 7hj, 7hs, 7io, (7qt), (7qw), 7ve, 7vf, (7wx), 7tq, 7wm, 7pf, (7sf), (7ba), (7iw) 7ak, 7zn, 7zl, (7zu), 7zv, 7aea, (7adg), 7afn, (7acx), 7aiy, (7adf), 7aha, 9ql, 9zt, 9aau, 9apf, 9bed, 9bhy, 9bxm, 9bzi, (9caa), 9cpu, 9cks, 9btl, 9bik.
Can.—5cn, (5go), 9bx. Will eastern stations pse. qsl?

By 8ATX, Pontiac, Mich.

Fone: 1xg, 2ccx, 5xaj, 5za, 7xi, 7zu, (af-2), (8di), 8ia, (8ii), (8ki), (8kj), (8vt), (8zz), 8awp, (8aqc), (8aso), 8atn, 8bbe, (8bbj), (8bcu), (8bdr) 8bvy, 8cih, 8xae, 9xm, 9yf, Can. 9hm.
C. W.: (1af), 1ap, 1dl, 1gs, 1gv, 1ii, 1il, 1kc, 1mc, 1my, 1rv, 1sn, 1uj, 1xm, 1xp, 1abf, 1adl, 1ajt, 1aok, 1aql, (1asi), 1bai, 1ban, 1bas, 1bes, 1bfe, 1bie, 1bkq, 1boq, 1brl, 1bwj, (1byn), 1ckp, 1cmi, 1cmp, 2cx, 2fp, 2om, 2rb, 2rw, 2sq, (2wr), 2xq, 2aax, 2acd, 2afb, (2agb), 2agd, (2ais), 2aja, 2ats, (2awf), (2axf), 2ayv, 2bbb, 2bmr, 2bqh, 2bum, 2bzv, 2ccd, 2ccx, 2cgt, 2chl, 2cka, 2ckk, 2cla, 2cpk, 2csl, 2cur, 2cvj, 2cvu, 2cxl, 3ab, 3cf, (3cx), 3bg, 3ds, 3fp, 3fq, 3hg, 3hh, 3hs, 3oe, 3oh, 3ov, 3pz, 3sk, 3sx, 3te, 3tr, 3vw, 3wf, (3xm), 3xt, 3yo, 3zo, (3zp), 3zz, 3abw, 3adb, 3adx, 3ajj, 3aka, 3ale, 3alu, 3amw, 3apr, 3arp, 3asc, 3asp, 3ats, 3bav, 3bdm, 3bei, 3bgj, 3bgt, 3bhm, 3biy, 3bkh, 3bob, 3bof, 3brl, 3bsb, 3buy, 3bva, 3bwt, 3cbz, 3cbu, 3cfq, 3cpa, 3cty, 3xaa, 4ab, 4ai, 4ar, 4bd, 4bv, 4bx, 4cy, 4fa, 4fq, 4fs, 4fv, 4hj, 4hw, 4jh, 4jl, 4km, 4mb, 4me, 4oi, 4pm, 4qz, 4ya, 4yo, 5bm, 5bw, 5cy, 5da, 5ek, 5en, 5ga, 5gj, 5jb, 5kc, 5kn, 5kw, 5lf, 5ln, 5mb, 5ml, 5mo, 5nk, 5nz, 5ov, 5pn, 5qm, 5qv, 5rh, 5sk, 5sp, 5tc, 5uk, 5uo, 5xb, 5xk, 5yq, 5za, 5zh, 5aah, 5abh, 5agj, 5ahc, 5ahr, 5aht, 5aiu, 5xad, (5zab), 5zaba, 5zat, 6lu, 6zh, 6agj, 6anh, 6xad, 7zo, 7zu, 7zv, 8's too numerous, 9bf, 9ei, 9ej, 9ep, 9dk, 9dz, 9hk, (9ig), 9il, (9jk), (9lh), 9mo, 9of, 9ox, 9qf, 9qj, 9qr, 9rc, (9uh), (9vz), 9xm, 9yh, 9zi, (9zt), 9aal, 9aap, (9aar), 9aav, 9aec, 9aey, 9adf, 9afk, 9ahz, 9aiw, 9aix, 9alx, 9amt, (9anq), 9aog, 9apd, 9ape, 9aps, 9apw, 9arc, 9ari, 9ase, (9atn), 9ato, 9aul, 9aus, 9avn, 9avz, 9awg, 9aws, 9ayd, 9aza, 9aze, 9baf, 9bak, 9bav, 9bcb, 9bds, 9bed, 9bhi, 9bhm, 9bij, (9bjc), 9bjt, 9bkj, 9boo, 9bop, 9bov, 9bqw, 9brh, 9bri, 9brk, 9bsg, 9bsq, 9bst, 9bsz, (9bta), 9bvy, 9bxm, (9bxt), 9byt, 9bzi, (9bzo), 9bzz, 9cba, 9cbt, 9ces, 9cdb, 9cdu, (9ced), 9cee, 9ceh, 9cfb, 9cgk, 9cgu, 9chy, 9cin, 9cja, 9cjc, 9ckf, 9cki, 9ckm, 9ckp, 9clz, 9cmk, 9cnv, 9cqo, 9cpb, 9cpq, 9csr, 9ctr, 9ctv, 9cuc, 9cui, 9cvo, 9cxo, 9cyu, 9cyw, 9dbh, 9dfq, 9dge, 9dgn, 9dhr, 9dhs, 9djn, 9dkx, 9dky, (9dma), (9dpx), 9dqu, 9drn, 9duq, 9dvl, 9dwf, 9dmn, 9dwu, 9dxc, 9dxk, 9dxm, 9dyn, 9dyu, 9dzb, 9eak, 9ean, 9ear, 9edk, 9eey, 9ehn, 9ekf, 9xaq.
Can.—(3ad), 3co, 3dh, 3gb, 3jl, 3nb, 3ni, 3oh, 3pg, 3si, 3sx, 3uz, 3xm, 4co, 9aj, 9al, 9aw, 9bu, 9bw.

Continued on page 44

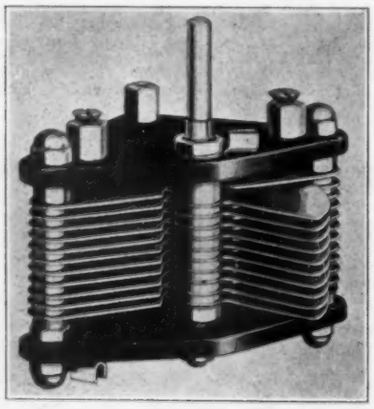
NEW APPARATUS & SUPPLIES FROM THE RADIO MANUFACTURERS



PACENT NEW VARIABLE CONDENSER

The new Pacent 200 type variable condenser was developed in accordance with a demand which was assumed to exist for a condenser, incorporating the best in materials, workmanship and design. The heads are made of genuine bakelite, a material combining the best insulating and physical qualities. The bakelite heads fundamentally insure this condenser against any possibility of warping. The plates are made of extra heavy (.025") aluminum of a special degree of hardness. They cannot buckle. All metal parts are aluminum or brass except the shaft which is needle bar steel. The brass parts are heavily nickel plated.

The design was produced by the faithful effort of experience radio engineers and the best workmanship has been employed in its execution. Instead of using the ordinary method of spacing the plates with washers, the plates themselves have been machined



Pacent New Variable Condenser

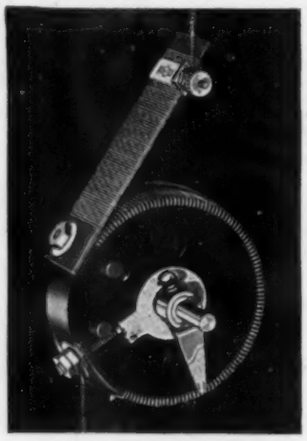
into a spacer. These spacers can be machined to one-half thousandth of an inch, insuring absolute accuracy of spacing. Being an integral part of the plate, this type of spacer greatly increases the rigidity end sturdiness of the condenser assemblage. The upper bearing of the condenser comprises a ring, separated into four fingers which are finely adjusted to exert exactly the right pressure against the shaft. The continuous wide surface contact of this bearing with the shaft insures a perfect electrical connection and is a great improvement over the ordinary type of construction.

In the lower bearing the stationary part is of brass and the movable part, steel. This is the best wearing combination of which bearings can be made. The lower bearing is adjusted and can be locked after adjustment is made. These special bearing features assure perfect permanent alignment of the plates. The careful assemblage and accurate adjustment affords a smooth, velvety rotation of plates which makes tuning a pleasure.

CUTLER-HAMMER RADIO RESISTANCE UNIT

With the advent of the new one-quarter ampere receiving tube, there has arisen the need of a rheostat of larger resistance than the 4 to 6 ohm types now on the market. When using a fully charged 6-volt storage battery, it is necessary to insert a rheostat of about 30 ohms resistance in the circuit to handle the new tube.

To meet this condition, The Cutler-Hammer Mfg. Co., Milwaukee, has developed a



C-H Radio Resistance Unit Attached to Rheostat

variable resistance of 25 ohms to be used with the standard rheostats now on existing apparatus. It is not necessary to remove the rheostats now on your set. Simply unscrew the binding nut from one terminal of the rheostat, remove wire and slip eyelet of C-H resistance unit over the binding post. Replace nut, tighten, and fasten loose wire to binding post on slider of C-H unit.

Switch on the *A* battery, move the slider to the best operating point and use rheostat in the usual way. By the use of these additional units it is a simple matter to adapt the rheostats on your set to the use of the new amplifying tubes. This change-over is well worth while, as the ¼ ampere tube not only takes one-fourth the current as compared to the older tubes, but increases the volume and clearness of reception to a remarkable degree.

NEW RADIO CATALOGS

Electric Specialty Co., Stamford, Conn., has issued an eight-page folder giving reproductions of many letters received from satisfied users of "Esco" motor-generators for radio transmitting sets.

"Na-ald Circuits" is title of a neat booklet from the Alden Mfg. Co. of Springfield, Mass., showing the application of their products to five circuits, the Reinartz, Flewelling, single tube reflex, Neutrodyne, and an improved single circuit tuner.

The Radiall Co., with factory at New Haven, Conn., advises that its main office is now at 654 Grand Ave., New Haven, Conn.

"Plastic Moulding" is the subject of an attractive booklet from the Shaw Insulator Co., of Irvington, N. J. It tells how moulded materials are manufactured and illustrates some of the many purposes to which Condensite is applied.

KELLOGG RADIO HEAD SETS

The Kellogg Company has been receiving a very large number of voluntary testimonial letters on the value of the Kellogg radio head set. Almost without exception, these letters play up its volume and clearness. Those who are the most enthusiastic fans, namely those who stay "glued" to their sets until one and two o'clock in the morning, are the most appreciative of its small size and extreme lightness. The Kellogg Bakelite receiver shell is non-metallic and all terminals are entirely enclosed within the shell.

The cap is of the most approved design, the concave surface being the result of years of practical telephone receiver construction. The diameter of this cap is 2/16 inches, and it screws into place with heavy threads which will not allow the cap to slip in any ordinary usage. When two people

desire to use one set or one receiver each in listening, the head band is instantly removable and as equally easy to replace when desired.

They are wound to 1200 ohms per receiver, 2400 ohms per set. The magnet is special tested steel. This receiver has concealed binding posts which does away with tampering or any adjusting. The magnet windings are of great accuracy, the mountings, end plates, wire, insulation and insulating of the wire are all of the highest grade and of the material best suited for the purpose. Kellogg tested diaphragms are of the correct thickness for this work, and the assembled receiver is an equipment of the most dependable character, giving a service that very many users claim is superior to any other type radio receiver on the market.

Continued on page 94

It's Ready—The Ideal Summer Set!

Enjoy Radio concerts at your summer cottage.

A welcome addition to the camper's kit.

Take it with you wherever you go.

All Kennedy Receiving Sets are regenerative—licensed under Armstrong U.S. Patent No. 1,113,149.

Light, Compact, Portable—Just the Thing for Summer Outings and Home Use

Here is the ideal Summer Radio Set! Just the thing to take with you on your vacation—auto touring, boating, camping, or to your summer cottage. A handy, compact set, so easily transported from place to place that you can take it with you wherever you go—yet so exquisitely finished that you will be glad to have it in your home.

Reduces Interference

This new set is the latest triumph of the Kennedy Engineering staff. It has all the beauty, refinement and perfection of detail that distinguishes the Kennedy line and makes it the "Royalty of Radio." It is simple to operate, yet highly selective, with unusual freedom from interference—the ideal summer set.

No Storage Battery Needed

The Kennedy "Portable" is designed for use with any standard tube, including the dry-cell type. When dry-cell tube is used, the set is entirely self-contained, space being provided in the sturdy, beautiful oak cabinet for dry batteries and phones. Size 15x7½x7, weight 17 lbs. Complete, with tube, dry batteries and phones, $75.00.

See the nearest Kennedy dealer for demonstration, or write for descriptive literature on this and other Kennedy sets.

THE COLIN B. KENNEDY COMPANY
SAINT LOUIS SAN FRANCISCO

KENNEDY

The Royalty K *of Radio*

Yes—why don't you?

Does your set "sign-off" because your battery quits?

Are you reminded—when a good program is on—that your outfit is of no further use until you lug the battery down town and back?

Keep the battery at home, keep it full of pep and prolong its life with Tungar.

Tungar—the go-between from house-lighting circuit to storage battery—puts an end to unheard and half-heard programs.

Just connect Tungar—turn on the current and charge the battery while you sleep.

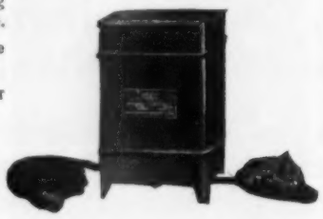
Tungar is *certain, clean, quiet.* No moving parts to get out of order. Inexpensive to operate.

Good for your auto battery too—the same Tungar.

See Tungar at any good electrical shop, or write for literature. Address Section Rd6.

Merchandise Department
General Electric Company
Bridgeport, Connecticut

Tungar Battery Charger. Operates on Alternating Current.
2 Ampere Outfits—$18.00
5 Ampere Outfits—$28.00
(Prices east of the Rockies)
Special attachment for charging 12 or 24 cell "B" Storage Battery—$3.00—fits either size Tungar.



Charge 'em at Home, with
Tungar
BATTERY CHARGER
A GENERAL ELECTRIC PRODUCT

35A—97D

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9ZAF **from DENVER** KLZ
The exclusive distributors of
KENNEDY EQUIPMENT
IN THIS TERRITORY
If you have a KENNEDY Receiver you have the best in Radio
REYNOLDS RADIO CO., Inc., 1534 Glenarm St., Denver, Colo.
Largest distributors of Radio Apparatus in the West
? Did YOU receive our 68-page Catalogue ?

CALLS HEARD

Continued from page 41

By 6BOS, Piedmont, Calif.

Spk: (6dd), (6gr), (6gt), (6ic), (6ke), (6kc), (6km), (6od), (6ol), (6pq), (6qk), (6qr), (6tf), (6up), (6vv), 6wi, (6zh), 6zr, 6aau, (6abw), (6acr), (6adl), 6agf, (6agk), 6ahf, (6ahp), (6ahu), (6aic), 6akl, (6ald), (6alg), (6amw), 6anl, (6anp), (6aow), (6apd), (6apl), 6aqd, (6ark) 6asc, (6aud), (6avr), 6awh, 6zal, (6bae), (6baj), (6bak), (6bbe), 6bbv, (6bcn), 6bip, (6bjg), 6bjm, (6bju), (6bks), (6blm), (6bny), (6bqt), (6bqx), (6bra), (6brb), 6btb, (6buh), (6bvd), 6bwe, 6bwd, (7cz), (7gq), (7kj), 7iw, 7mc, 7nw, (7oh), (7tw), (7ws), 7abh, (7aea), (7aff), 7afo, 9aaw, 9auu, 9dpn, 9dsa.

C. W.: 2bh, 4ec, 4eh, 4ey, 4za, 5ct, 5di, 5ek, 5go, 5ka, 5mz, 5nk, 5px, 5sr, 5tt, 5uo, 5xd, 5za, 5zh, 5zq, 5ado, 5ahd, 5aic, 5zak, 5zas, 6's and 7's too numerous, 8ib, 8mp, 8yd, 8aaf, 8xae, 9dx, 9dr, 9hr, 9kk, 9kp, 9lz, 9pn, 9wu, 9zx, 9xaq, 9abk, 9aiy, 9aku, 9akm, 9ami, 9asc, 9aua, 9avz, 9awm, 9zaf, 9bbf, 9bji, 9bly, 9bof, 9bxq, 9bzi, 9cjr, 9cns, 9cwr, 9dky, 9dtm, 9edm. Canadian: spk—3ec, 5ad, 5go, 5hd, 9bd. C. W.—9al, 9bx, 5cn, 5go, 5ct, 5srri.

By 6BWU, Sebastopol, Cal., Box E.

2xq, 2bqh, 4kk, 5go, 5hz, 5js, 5jt, 5nl, 5pn, 5xb, 5yq, 5za, 5zh, 5aam, 5ado, 5aic, 5bbt, 5zas, 5zht, 6's too numerous, 7ad, 7ak, 7bj, 7cg, 7dh, 7dp, 7hi, 7hj, 7ke, 7kf, 7lr, 7lu, 7lw, 7mc, 7na, 7nf, 7nv, 7om, 7pf, 7qt, 7ri, 7se, 7sy, 7tn, 7tg, 7tt, 7ve, 7vf, 7wm, 7zl, 7zn, 7zv, 7abb, 7adf, 7adi, 7afo, 7afw, 7agi, 7aic, 8ft, 8hn, 8qn, 8wx, 8xe, 8zw, 8afd, 8agn, 8alt, 8apw, 8caa, 8cdz, 8cih, 8cqh, 8cyu, 8dat, 9cr, 9fv, 9il, 9lz, 9of, 9uu, 9yb, 9abu, 9aec, 9aen, 9afk, 9amb, 9ami, 9apw, 9arz, 9atc, 9aus, 9axu, 9bed, 9bef, 9bhd, 8bji, 9bkk, 9bri, 9btl, 9bvy, 9bxm, 9bzi, 9eck, 9ccv, 9cpa, 9cwr, 9dkg, 9dng, 9dqm, 9dsm, 9dvw, 9dxe, 9dxm, 9dyn, 9edj, 9ekf, 9ekh, 9xaq. Can. 3bp, 3gk, 3jt, 4dq, 5ej, 5ct. Anyone hring my cw pse qsl. All crds answered.

By 5ZAV, Oklahoma City, Okla.

(1awb), 1ajp, 1apw (?), 1ajx, 1aw, 1boq, 1azl, 1bkq, 1cni, (1cmp), 1cdr, 1cnf, 1dek, (1gv), 1kc, 1ii, 1ts, 1yd, 1xm, 2acd, 2aqi, 2bqd, 2cqt, 2cei, 2cqu, 2ccd, 2cvj, 2cqz, 2ayv, (2coa), 2om, (2el), 2fp, 2ye, 2xq, 3alj, 3adx, (3auv), 3ajj, 3apr, 3afk, (3auw), 3bhw, 3blf, 3bhl, (3bgj), 3bva, (3ba), 3cel, 3cbz, 3cae, 3ca, 3fq, 3lz, 3nb, 3nf, (3su), (3te), 3tg, 3tj, 3hh, 3wf, 3pz, 3uc, 3tr, 3xk, 3xm, 3zo, 3zp, 4ag, 4ad, 4bi, 4bx, 4cn, 4cg, (4dn), (4eh), 4eq, 4eb, 4fn, 4fv, 4ft, (4fb), 4fq, 4ge, 4gq, 4hw, 4hj, (4ik), 4iv, 4jl, 4jk, 4jz, 4ku, 4km, 4la, 4me, 4nt, 4di, (4mb), 4ya, 4yd, (5ae), (5de), (5aib), (5aba), (5ek), (5kp), (5nv), (5pf), (5xb), (5xd), (5xad), (5xac), (5zaba), 6alx, 6aqw, (6awt), 6anh, 6ahk, (6ago), 6avv, 6bsq, 6bqw, 6bun, 6bmd, 6bbv, (6bqc), (6bvf), (6boe), 6biq, 6bbh, 6bjy, 6buh, 6bip, (6beg), 6bru, 6bvr, (6caj), 6cco, 6ckr, 6cgw, 6deg, 6ea, (6eb), (6ec), 6cu, 6gf, 6hp, 6if, (6lu), 6mh, 6rm, 6tc, (6xbc), 6xad, (6zh), (6zt), 6zf, 6zz, 7abc, (7aiy), (7abb), 7afw, 7aca, 7aii, 7bak, 7bh, 7ex, 7cn, (7hm), 7ln, (7gp), 7pf, 7sc, (7zb), (7zf), 7zn, 7zs, 7zu, 7zv, 8aaf, 8aak, (8adg), (8aeg), 8afd, 8afb, 8aco, (8avd), 8ahr, 8aik, 8anv, 8ape, 8aqi, 8ard, 8arx, (8atx), (8axt), 8aqi, 8aqv, 8awp, (8atn), 8ash, 8azg, 8azh, 8bae, 8bao, 8bbe, 8bch, (8beo), 8bek, 8ben, 8bey, 8bfq, 8jx, 8bda, 8bkh, (8bdv), (8boe), 8boa, 8bog, 8bgr, 8brl, (8bnh), 8btl, 8bxa, 8bxx, 8bay, 8buc, (8bqa), 8byn, 8byo, 8byf, (8caa), 8caq, 8cay, 8cbv, 8cbq, 8cbc, (8cei), 8cdd, 8afx, (8cgj), (8cgx), 8chb, 8cid, 8jy, 8jz, (8ckv), 8ckf, (8cwx), 8cnw, (8cno), 8cko, 8coz, 8cgu, 8cre, 8tv, 8cql, 8cpd, 8ctv, 8cuu, (8cur), 8cwu, 8crb, 8cxp, 8cxw, (8cyu), (8cyt), 8daa, 8dal, 8day, 8ddo, (8al), 8ab, 8bo, (8cf), 8ce, 8bf, (8fq), 8hn, 8hh, 8er, 8iq, (8ij), 8ib, 8jn, 8jy, 8ju, 8kc, (8kh), 8ls, 8lc, 8oi, 8pb, 8pk, (8pd), (8qk), 8qc, (8gz), 8tx, (8rj), (8vn), (8vl), 8rv, 8vy, 8ld, 8jy, (8wx), 8wv, 8ue, 8vq, 8xad, 8xan, 8xe, 8xg, (8yae), 8yaf, 8yu, 8zd, (8zw), 8zo, 8zz. Nof, bh7, "jh" qra? Canad. 2ni, (3jl), 3co, (3gk), 3xn, (3he), 3si, (4co), 4cn, 4hh, 4bv, (5go), 9aj, (9bp), 9bx. Fone (2el), (5ae), 5xaj, (5zm), 5za.

By 5AIF, 2923 Azle, Ft. Worth, Texas

(*ONE TUBE*). Spark—5id. 5mg, 5rb, 5ain, 5xac, 6apl, 9hj, 9ahq, 9aoj, 9aso, 9bmn, 9efc.

C. W.—2hh, 3su, 3apr, 4ag, 4ap, 4bi, 4bk, 4cg, 4cy, 4eb, 4el, 4gb, 4gz, 4ir, 4iw, 4jh, 4km, 4mb, 4me, 4mi, 4oi, 4pd, 4xj, 4ya, 4yd, 5's too numerous, 6cc, 6ea, 6jd, 6zh, 6zz, 6bab, 6ban, 6bcl, 6bvf, 7ab, (7zv), 8ag, 8cf, 8er, 8ij, 8vl, 8vy, 8afd, 8anb, 8aoq, 8bdb, 8bfx, 8bog, 8bsg, 8buc, 8bvr, 8cgx, 8cjy, 8cko, 8cwc, 8cwe, 8cwp, 8cyu, 8dag, 9ep, 9fd, 9ii, 9ox, 9pi, 9pq, 9qr, 9ur, 9vh, 9vz, 9aap, 9aau, 9acx, 9adf, 9afk, 9ahh, 9ahq, 9ahv, 9aih, 9aix, 9ami, 9ams, 9anf, 9ani, 9ano, 9aps, 9aqc, 9ari, 9arz, 9asd, 9ase, 9ask, 9atz, 9avg, 9avo, 9aza, 9bak, 9bbg, 9bbk, 9bds, 9bhw, 9bik, 9bil, 9bjc, 9bkc, 9bkg, 9bkj, 9bko, 9bog, 9bri, 9bsz, 9btt, 9bxc, 9cba, 9ccs, 9ccv, (9ceh), 9cfk, 9cfi, 9cii, 9cjy, 9cki, 9clw, 9cme, 9cmk, 9cns, 9cnv, 9cpv, 9cte, 9ctg, 9ctv, 9ddw, 9die, 9djb, 9dkq, 9dqe, 9dsw, 9dta, 9dwk, 9dxc, 9dyn, 9eak, 9ebi, 9ecz, 9efb, 9efh, 9ehj, 9ehn, 9eib, 9eiq, 9ekx, 9xaq, 9yb, 9yf, 9yar. Can. 3ni. Fone—5za, (5xaj), 9cns, 9dhb. (All hearing mi cw pse qsl crd. Wl qsl crd—tnx).

Continued on page 46

From Cuba to Canada with the Bradleystat

Retail Price
$1.85
Parcel Post 10c Extra

RADIO MAP LOG
"THE NEW METHOD OF LOGGING"
MANUFACTURED BY
LOUIS J. GALLO

Allen-Bradley Co.,
Milwaukee, Wis.

February 4th, 1923.

Gentlemen:

The best reply to your letter of the 26th is the enclosed map which shows the marvelous possibilities of my set. I attribute this strongly to the Bradlystats used for sharp tuning. It is absolutely necessary to have quick and fine adjustments without unnecessary tube noises.

I have used almost all rheostats, but I can honestly say I would use no other make than the Bradleystat. I copy outside stations while local ones are transmitting. I feel that my Bradleystats are responsible for most of it.

I am so thoroughly satisfied with my Bradleystats that I will gladly recommend them in any way.

Yours truly,

Louis J. Gallo

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The Bradleyometer is a perfect potentiometer for critical radio circuits. It is made in 200-ohm and 400-ohm sizes and gives precise voltage control without steps or noise.

The Bradleyadapter is a high-grade adapter for WD-11 tubes and will fit every standard radio socket. The contacts are silver plated.

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288 Greenfield Avenue
Milwaukee, Wis.

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PERFECT FILAMENT CONTROL

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Two thousand, three thousand, four thousand miles and more away—stations in every direction contribute to the daily pleasure of MU-RAD owners. The extraordinary sensitivity of these receivers, using only a two-foot, indoor loop aerial, provides continually new thrills and surprises. Remarkable clarity. Selects with astonishing distinctness. Easiest imaginable to operate. Nominal guarantee of 1000 miles reception.

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If you cannot attend the Radio Institute of America in person the same instruction can come to you through our recently inaugurated "HOME STUDY COURSE"—Investigate.

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Continued from page 44

3CAN, Philadelphia.

4ag, 4bg, 4cg, 4cy, 4dt, 4eb, 4el, 4fb, 4fj, 4hw, 4iv, 4jk, 4jl, 4km, (4mb), 4me, 4xv, 4ya, 4yd, 4zc, 5aec, 5all, 5bp, 5bm, 5da, 5di, 5dq, 5ek, 5fv, 5hz, 5iq, 5ix, 5kc, 5kp, 5mb, 5nv, 5nz, 5rh, 5sp, 5uk, 5xab, 5xad, 5xv, 5ye, 5zaba, 5zak, 5zav, 6cbg, 6cu, 6eb, 6ka, 6xad, 6zz, 7xs, 7zo, 7zu, 9acn, 9ae, 9afk, 9aix, 9alg, 9amu, 9anq, 9aoj, 9aps, 9apw, 9aqa, 9ari, 9asf, 9atn, 9ato, 9aua, 9aus, 9avz, 9aza, 9aze, 9azf, 9bak, 9bcb, 9bcf, 9bdu, 9bed, 9bhw, 9bik, 9bkj, 9blg, 9bly, 9boo, 9brk, 9bsg, 9bta, 9btl, 9bvp, 9bwf, 9bxm, 9xt, 9bzi, 9cba, 9cbz, 9ccs, 9ced, 9cee, 9ceh, 9cfb, 9cfi, 9cga, 9cgu, 9chd, 9chk, 9chy, 9cjc, 9cjm, 9ckg, 9ckw, 9clq, 9clz, 9cmc, 9cmk, 9cmt, (9cnv), 9cpa, 9cte, 9ctg, 9cto, 9cvo, 9cyw, 9czl, 9dgn, 9dgv, 9dhr, 9dky, 9dpr, 9dpv, 9dqu, 9dsg, 9dsp, 9dvk, 9dwf, 9dwp, 9dxc, 9dyu, 9ebh, 9efc, 9efh, 9ehn, 9eib, 9eij, 9eiq, 9ekx, (9ep), 9fk, 9hj, 9kp, 9mc, 9ox, 9oy, 9qr, 9ur, 9vz.

By 6CHV, R. R. Martindale, 1229 W. 24th St., Los Angeles, Calif.

C. W.: 3aro, 3bj, 3fm, 3fs, 4bq, 4bi, 4by, 4bd, 4eb, 4kc, 4oi, 4sw, 4ya, 4zc, 5ado, 5de, 5ek, 5iq, 5jb, 5kc, 5ke, 5pb, 5va, 5wz, 5xb, 5zas, 5zat, 5zaw, 5zh, 5zo, 7aft, 7afw, 7aic, 7ak, 7ba, 7dh, 7ln, 7me, 7ny, 7pf, 7sc, 7vf, 7zn, 8abs, 8asv, 8bch, 8bda, 8beo, 8bsf, 8bxx, 8caa, 8can, 8cf, 8cgj, 8vl, 8vq, 8xan, 8zo, 8zz, 9aai, 9aey, 9aig, 9aiy, 9aky, 9aod, 9apw, 9asu, 9ayu, 9aza, 9bch, 9bes, 9bgi, 9bji, 9bjk, 9bqi, 9bsg, 9bsq, 9bvy, 9bxc, 9bxm, 9cda, 9cdr, 9ceh, 9cew, 9cfy, 9cit, 9ctv, 9cxv, 9ddy, 9dhi, 9dio, 9dkq, 9dky, 9dlm, 9dtm, 9dts, 9dwk, 9fv, 9mg, 9zn, 9zy.
Phone 5px, 9bhg, 9zaf; Canadian 4hh, 9bx.

(Heard on Feb. 3rd)

All C. W.: 1bwj, 1xak, 1xm, 2xu, 3bv, 3can, 4db, 4eb, 4eh, 4jy, 4oi, 4sw, 4ya, 4zc, 5ado, 5ahd, 5ek, 5ho, 5ix, 5ns, 5rj, 5zab, 5zat, 5zaw, 5zax, 6's too numerous, 7adm, 7dh, 7ds, 7ln, 7lr, 7mc, 7sc, 7we, 7wq, 7zn, 8aim, 8anb, 8apw, 8aqf, 8azg, 8bch, 8bda, 8bdo, 8bdu, 8beo, 8bfq, 8bfy, 8bo, 8bxx, 8cei, 8cgx, 8cmi, 8cp, 8cpd, 8dao, 8er, 8qk, 8vy, 8wx, 8xe, 8zae, 9abv, 9aig, 9aiy, 9ami, 9aps, 9apu, 9arz, 9bcf, 9bch, 9bhd, 9biq, 9bji, 9bkj, 9bkm, 9bm, 9bsg, 9bvy 9bwj, 9bxa, 9bxm, 9caa, 9cba, 9ccv, 9ceh, 9cfy, 9ctv, 9cuc, 9cwr, 9dah, 9dca, 9dge, 9dgn, 9dio, 9djb, 9dky, 9dlm, 9dsd, 9dsm, 9dta, 9dfw, 9dwk, 9dx, 9edb, 9ei, 9ekh, 9ep, 9ps, 9ve, 9xac, 9xm, 9yy, 9zt. 9zy.
Canadian: 3dh, 3xn, 4bv, 5ek, 9bx.

By 6ARB 5029—Acton Street, Berkeley, Calif.

2fp, (2cqz), 4eh, 5hz, 5zg, (5aec), (6cu), (6ke), (6mf), (6su), (6bhv), (6bic), (6bmo), (6bmx), (6bqq), (6brf), (6bsq), (6bun), 6bve, (6cfm), 6cgg, (7hj), 7ng, (7tt), 7ws, 7aff, 8ab, 8bda, 8cmi, 8cpd, 9ig, 9pi, (9qf), 9uh, (9vm), 9yb, (9abu), 9avu, 9bgg, 9bjk, (9bkj), 9bkp, (9bsg), (9btl), 9bun, 9bvy, (9bxm), (9ccv), 9ccy, 9ced, 9ceh, (9cfy), 9cjy, (9cki), (9cns), (9cpu), (9ctv), (9cvo), 9dky, 9dug, 9dwn, 9eil, Can. 5go, 5cn, 9bx.

By 6BRF, 1420 Le Moynest, Los Angeles, Cal.

5ka, 5la, 5tc, 5px, 5ek, 5cn, (5abh), (5abd), (5ado), 5za, 5zb, 5ze, 5zh, 5zak, 5zav, 5xa, 5yo, (6hv-with voice), (6alx-with voice), (6and-with voice), (6bru-with voice), 7am, 7aw, (7bj-with voice), 7sc, 7wm, 7hf, 7qt, (7tq), 7pf, 7dp, (7mf), 7wy, 7na, 7ln, 7lr, 7jw, 7tt, (7lw), (7hj), 7tt, 7abh, 7aea, 7zl, 7zv, 7xk, 7zu, (7zo), 7ya, 8vy, 8bsy, 8bch, 8boe, 8aqv, 8beo, 8brc, 8cmi, 8zy, 8zw, 8xv, 8xae, 9ll, 9ox, 9aoi, (9aiy), 9asf, 9ami, 9awm, 9awu, 9awe, 9amd, 9aua, 9bxm, (9bxq), 9bxa, (9bji), 9bjj, 9bjw, 9bun, 9bzz, 9bkp, 9bki, 9bkj, 9caa, 9cac, 9cau, 9cay, 9cjw, 9cfy, 9cns, 9cip, 9cte, 9bya, 9dsd, 9dky, 9eea, 9zu, 9zaf, 9xaq.
2fp, 3apw, 3zo, 3zy, 4bw, 4ri, 4bf, 4tc.
All hearing my cw or fone pse qsl with card. All crds gladly ans.

At 6AAJ, 206 Ellsworth Ave., San Mateo, Calif.

All C. W., on one tube—2xq, 3bq, 3gk, 4bv, 4eh, 4fs, 4hh, 4ya, 5aa, 5ej, 5ek, 5ga, 5hz, 5jd, 5js, 5kc, 5mb, 5nz, 5ov, 5sp, 5uj, 5aar, 5abk, 5adb, 5ado, 5xb, 5xv, 5xad, (5za), 5zh, 5zab, 5zas, 5zax, (6bm), (6ea), 6ef, (6fy), (6ku), 6ol, (6aag), (6aib), (6aoi), (6apw), 6atj, 6atq, (6bae), 6bcl, 6bgc, (6bik), (6bjj), (6bjq), (6bmo), (6bnx), (6bqk), 6bun, 6but, (6bvg), (6cfm), 6zz, 7dh, (7dp), (7du), (7ge), (7gp), 7hd, 7hi, (7hj), 7hm, 7io, 7jg, 7jw, 7ks, 7mc, 7my, 7na, (7nf), 7ny, 7om, (7ox), (7pf), (7qn), 7ri, 7ro, (7sc), (7sn), 7to, 7tq, 7ut, 7ve, 7vf, 7we, (7wm), (7abb), 7abh, 7aea, (7aff), 7afo, 7aft, 7afw, 7agi, 7ahw, 7aif, 7aip, 7aiy, 7ajq, 7asu, 7xt, 7zf, 7zg, 7zl, (7zn), 7zu, 7zv, 8ab, 8cf, 8cp, 8jy, 8sp, 8ue, 8vy, 8ard, 8asv, 8bch, 8bcy, 8bdb, 8bog, 8bxh, 8caa, 8cbk, 8chb, 8crb, 8cuu, 8cxw, 8yn, 8yv, 8xe, 8zw, 8zz, 9bx, 9cq, 9cr, 9gk, 9ig, 9lz, 9pc, 9qf, 9uh, 9uu, 9vm, 9ami, 9anq, 9aps, 9apw, 9asf, 9aua, 9avu, 9ayu, 9bcf, 9bed, 9bji, 9bjk, 9bkp, 9bly, 9bri, 9bsg, 9bun, 9bxc, (9bxm), 9bzi, 9caa, 9cba, 9ccv, 9cdu, 9cga, 9cjy, 9cmk, 9coc, 9cpb, 9dgv, 9dhs, 9djm, 9dkq, 9dky, 9dqm, 9dsm, 9dte, 9dvj, 9dwk, 9dwn, 9dyn, 9dyw, 9edb, 9xaq, 9yb, (bt3), ad7. Can. 3ni, 4eb, 5cn, 5ct, 5go, 5hg. Using 5 watter here. Will be glad to qsl any of above.

Continued on page 48

THINK of your Radio receiving set as a kind of camera whose "film" is sensitive to *sound* waves instead of *light*.

Developing this "film" into real "sound pictures" is the whole art of Radio usefulness and enjoyment.

For this, no apparatus has ever been evolved which gives results equal to those produced by Magnavox Equipment.

R2 Magnavox Radio
(With 18-inch horn)

This instrument is intended for those who wish the utmost in amplifying power; for clubs, hotels, dance halls, large audiences, etc. It requires only .6 of an ampere for the field. Price **$60.00**

R3 Magnavox Radio
(With 14-inch horn)
As illustrated

The ideal instrument for use in homes, offices, amateur stations, etc. Same in principle and construction as Type R2.
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As illustrated

For use with the Magnavox Radio and insures getting the largest possible power input.
AC-2-C, 2-stage, $55.00
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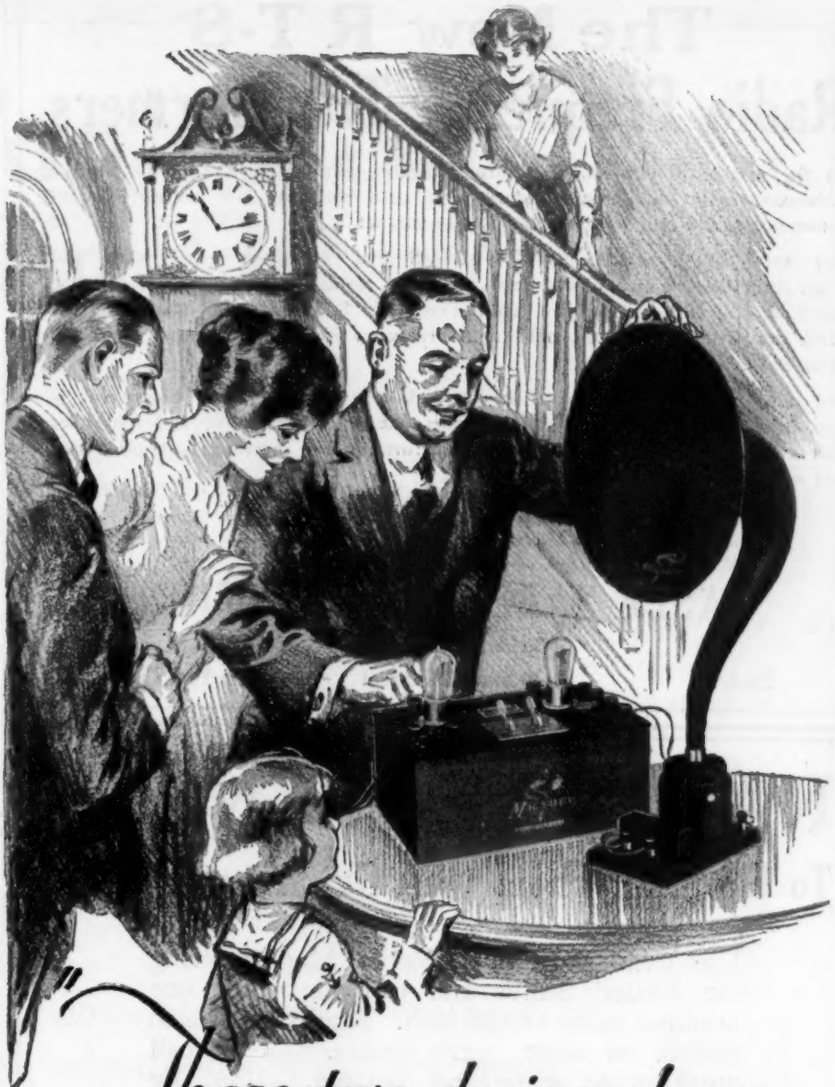
Magnavox Reproducers and Power Amplifiers can be used with any receiving set of good quality. Without Magnavox, no receiving set is complete.



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By 6CAH, Robert Nagle, Van Nuys, Calif.

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By 9ZT, D. C. Wallace, 54 Penn Ave., N. Minneapolis

(1aw), 1fd, 1gv, (1hx), 1ii, 1qp, 1rd, 1ts, 1xu, 1ban, 1bes, (1bkq), 1boq, 1cdi, 1cja, 1cmk, 1cmp, 2cq, 2fp, 2kf, 2nz, (2om), 2rz, 2xl, 2xz, 2afp, 2agv, 2bmr, (2brb), 2bzv, 2cbw, 2ccd, 2ckl, 2cpa, 3ab, 3ax, 3cx, (3fp), 3fq, 3fs, 3gc, 3hg, 3hk, 3su, 3sw, 3tr, 3yo, 3zo, 3zp, 3adx, 3aln, 3apr, 3aro, 3bjc, 3bng, 3can, 4dn, 4fs, 4hw, (4km), 4aac, (5be), (5bw), (5ek), (5el), (5ho), (5jj), (5kc), (5kn), (5kw), (5mo), (5nz), (5pb), (5px), (5sk), (5uz), (5wh), (5za), (5zh), (5adb), (5aec), (5and), (5aib), (5xab), (5zas), (5zaba), 6cu, (6ea), 6eb, 6gf, (6if), 6ir, (6jn), 6jx, 6ka, 6mh, 6zh, 6zw, (6zz), (6aak), 6abk, 6abx, 6agj, 6anh, 6apw, 6awt, (6awx), 6beg, 6bjq, (6boe), (6bun), 6bvf, 6bvg, (6caj), 6cgw, (6xad), 7ec, (7eq), (7jw), 7lf, (7lr), 7lu, (7pf), 7wx, (7zn), 7zo, (7zu), 7zv, (7abb), 7afw, (7aiy), (8aa), (8ab), (8cf), (8cp), (8fu), (8jj), (8nv), (8pb), (8qk), (8uc), (8vy), (8wa), (8wv), (8zd), (8zn), (8adk), (8aiz), (8aio), (8atx), (8aiz), (8aio), (8akc), (8apt), (8apw), (8aiz), (8aio), (8akc), (8apt), (8apw), (8asz), (8atx), (8avd), (8bbe), (8bcy), (8ben), (8bgl), (8bgq), (8bib), (8boe), (8bog), (8brd), (8buc), 8cap, (8cap), (8cbi), (8cgj), (8cmi), (8cpd), (8cur), (8cvu), (8daa). Canadian, 3bq, 3co, (3de), 3gk, 3oj, (3si), 3ni, 3uc, 3xn, 3zl, (4bv), (4cn), (4co), 4dq, (4hh), 4kl, 3nb, (9al), (9bx).

By George Tajbl. 2510 S. Homan Ave, Chicago

On detector Trv—2brg, 3apr, 3asp, 3ccd, 3bmo, 3my, 3pl, 3pz, 3wb, 4fa, 4mi, 4oi, 4rp, 5aiu, 5bw, 5da, 5ek, 5la, 5mb, 5mo, 5rk, 5sp, 5sw, 5xaa, 5xaj, 5xb, 5xv, 5ye, 5zav, 5zi, 8aaf, 8aip, 8anb, 8axd, 8azh, 8bbe, 8bi. 8bis, 8bmy, 8bo, 8buc, 8cdd, 8cim, 8cef, 8cqx, 8cjy, 8cpd, 8cqx, 8crc, 8cws, 8cw, 8cwc, 8ls, 8on, 8vl, 8vy, 8wp, 8yal, 8xam, 8zo.

By 6ASL, Lyle Anderson, 1816 Broderick St., San Francisco

Can. C. W., 5cn, 5ct, 5go, 9bx.

U. S. C. W., 5ga, 5ado, 5aib, 5zak, 5zh, 6bki, 6buo, 6cbu, 6cgg, 6ckf, otr 6's omitted, 7ak, 7dh, 7go, 7hb, 7hi, 7hs, 7jc, 7js, 7my, 7ng, 7ri, 7sn, 7abb, 7abh, 7adm, 7afw, 7zh, 7zf, 8ft, 9uh, 9uu, 9asf, 9avu, 9aku, 9ayu, 9aey, 9bjk, 9bjm, 9bun, 9bzi, 9bzz, 9cuc, 9chn, 9dge, 9dgi, 9dvj, army bt3.

By 6OL, R. M. White, 1509 So. Brand Blvd., Glendale, Calif.

C. W., 1ag, 5ek, 5ir, 5kc, 5px, 5qy, 5uj, 5xb, 5xd, 5xt, 5xaj, 5za, 5zak, 5zav, 5adb, 5ado, 5aec, 5agj, 7bu, (7bj), 7cz, 7dp, 7ey, 7jw, 7ln, (7mf), 7nf, 7ny, 7na, 7ot, 7pf, 7qt, 7sc, 7tg, 7tq, 7vf, 7xf, 7zf, 7zn, 7zo, 7zu, 7zv, 7aic, 7abb, 8cf, 8yd, 8zy, 8aoc, 8cun, 8cur, 9bx, 9kp, 9ps, 9ql, 9xaq, 9yaj, 9zt, 9zaf, 9aix, 9ajh, 9amb, 9aul, 9awm, 9aym, 9bed, 9bik, 9bji, 9bxa, (9bxm), 9bsg, 9cfy, 9cns, 9cwr, 9dgv, 9dtm, 9ekh. 6ol's spark reported by kkei while anchored in Bristol Bay, Alaska. Would appreciate reports from those hearing my cw.

At Fairmont, Minn.

C. W.: 1aip, 1bas, 1bes, 1btr, 1cmp, 1il, 1iv, 1sn, 1wi, 2abg, 2abq, 2abw, 2af, (2anm), 2blp, 2brg, 2bqd, (2bzv), (2ccd), 2ckk, 2ckl, 2cur, 2cvj, 2fp, 2hg, 2hj, 2rd, 2rm, 2xq, 3akr, 3ami, (3apr), 3bhm, 3bkl, 3blg, 3blp, 3bva, 3cbz, 3dfq, 3hd, 3ko, 3me, 3nb, 3qe, 3sk, 3tl, 3tr, 3uz, 3wf, (3xal), 3xm, 3xn, 3zo, 3zp, (4ag), 4az, 4eb, 4eh, 4fb, 4do, 4iv, 4jf, (4km), 4pd, 4ya, 4yd, 4zc, 4bq, 6apw, 6aqp, 6aqw, 6awt, 6awx, 6baw, 6beg, 6beq, 6bip, 6bpl, 6bun, 6bvf, 6bwb, 6caj, 6cbg, 6cay, 6cgw, 6cu, 6if, 6qa, 6ti, 6zh, 7afo, 7ahc, 7ba, 7bh, (7dh), 7hi, 7pf, 7sc, 7vf, 7zl, 7zu, 7zv, Canadian: (3ni), 3jl, 3pg, 4co, (3oh), 9bx. Worked 5za 900 miles 1½ hours after sunrise. 9dsw would appreciate reports from west coast stations hearing him.

Continued on page 78

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MONEY saved is money earned. Radio enthusiasts want the most for their money. Here is an opportunity for you to get unusual value for your subscription dollars.

"POPULAR RADIO" and "RADIO" (San Francisco) known the nation over for the wealth of practical information they contain, in addition to a mass of most timely radio news, valuable constructional data for those who "roll their own," feature articles by the leaders of the industry, the latest radio developments and discussions on everything worth-while talking about, have joined forces in a great money-saving clubbing offer in order to give *you* these leading two radio publications at a cost very little more than the subscription price of either magazine alone. Just imagine—you can subscribe to *both* "POPULAR RADIO" and "RADIO" for a full year for only $3.00—a saving to you of $1.50 over what you would pay for them separately.

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The Receiver that Satisfies

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Type B-R Receiver

fully meets the requirements of the discriminating purchaser because of the following features:

EFFICIENCY OF OPERATION: Securing volume, distance (1500 miles with single tube is not unusual), selectivity. Broadcasting stations one-half mile distant are tuned out by a slight turn of condenser dial.

EASE OF OPERATION enabling the novice to secure satisfactory results.

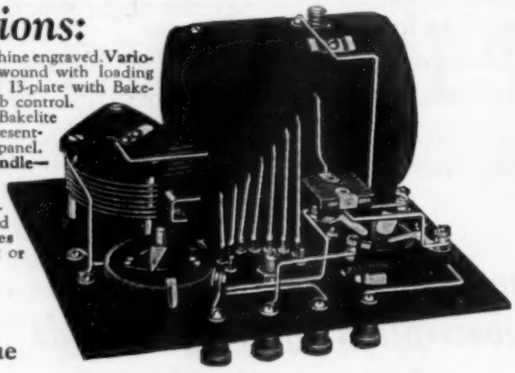
HIGHEST QUALITY OF WORKMANSHIP AND MATERIALS.

PRICE within the reach of everybody.

Manufactured exclusively for us by the Tri-City Radio Electric Supply Co., licensed under Armstrong U. S. Patent No. 1113149, October 6th, 1914.

Specifications:

Panel—Formica, grained and machine engraved. **Vario-Coupler**—Telmaco special silk wound with loading inductance. **Condenser**—Special 13-plate with Bakelite ends. **Rheostat**—Single knob control. **Socket**—Highly nickeled shell, Bakelite base. **Dials**—are polished, presenting pleasing contrast with dull panel. **Telmaco Adjustable Vernier Handle**—secures extremely fine tuning and entirely eliminates body capacity effects. **Workmanship**—manufactured according to Telmaco's rigid specifications. **This Guarantees Your Satisfaction.** Either 6 volt or 1½ volt tube may be used.



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TELMACO Type B-A Two Stage A. F. Amplifier

Matches the above in size and construction. The greatest Amplifier value on the market. Price $20.00.

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with insulated binding posts and 7' Copper Wire Connectors

Pacific Coast Representatives

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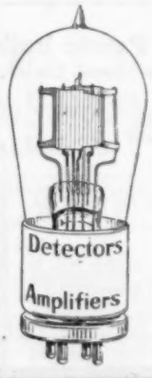

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Your dealer should know, but if he does not, send direct to

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Tubes returned Parcel Post C.O.D.

HOW TO BUY APPARATUS

Continued from page 16

Are they made in such a way that they will last without breaking off after continued use? Is the winding put on so it will stay and is it effectively protected from moisture? In the case of a vario-coupler the connection to the secondary should be made through a little coiled phosphor bronze spring.

Nowadays we must constantly be on the alert for bootleg vacuum tubes. All of the more subtle recourses of the inexperienced imitator have been used in these tubes—that is, as far as appearances are concerned. In operation it is quite a different matter. At the present time there are only six people licensed to manufacture tubes. They are: The Radio Corporation, DeForest Telephone & Telegraph Co., E. T. Cunningham, The Myers Co., Westinghouse Company and Western Electric Company. Three-element tubes that do not bear any one of these names are illegitimate offsprings. Some of them function fairly well, but more of them do not. This is because they do not have the oxide coated filament, and usually the filament has a very short life.

The writer has seen some very cleverly made bootleg tubes, from the standpoint of imitation, but like the counterfeiters of money, the imitators always neglect some important little point that entirely exposes their trickery. Tubes are available that look exactly like Radiotrons, save for the bottom of the base where, in place of porcelain we will find a cheap piece of fibre. Imagine trying to work one of these tubes as a radio frequency amplifier with a fibre insulation base probably full of moisture.

Although there are plenty of good 'phones on the market, the average radio fan is not qualified to pick out the good from the bad. The 'phone is a very vital instrument, and the success or failure of a receiving outfit depends entirely upon the headset. When we recall that we cannot hear radio signals without a loud speaker or a headset, we can understand that the purchase of this device is worthy of serious attention. We should not let the dealer kid us into buying a pair of 'phones with a high resistance for resistance' sake. The relationship between resistance and sensitivity is very remote—they are sort of distant cousins. The fact that a 'phone has a resistance of 4000 ohms does not mean that it is more sensitive than a 'phone with a resistance of 2000 ohms.

The 'phones are the only part of the radio set that we wear, and therefore the matter of comfort enters into the argument. We want 'phones which will not partially scalp us every time we take them off. We want a headset that will exert just a comfortable pressure on the ears. And let us remember that the sur-

Continued on page 52

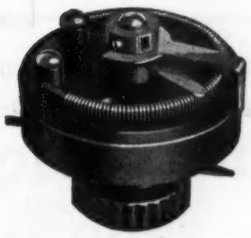
JUST so sure as this magic called Radio is here to stay, just so sure will SIGNAL folks be making Radio apparatus. For in manufacturing Radio equipment, as in every other phase of human life, the law of the survival of the fittest holds good.

The big thing in SIGNAL survival and success is that SIGNAL Radio sets and parts are designed for service. They're made right. They look right. They work right. Expert engineering, fine materials, workmanship of utmost precision, all guarantee this.

Getting right down to brass tacks, when professionals tell us that they *"get what they want when they want it"* with SIGNAL apparatus—when amateurs tell us that they *"get what's going and get it easily"* with SIGNAL apparatus—and they do tell us that repeatedly—then *you* can buy SIGNAL apparatus and *know* that it will "deliver the goods."

For sale by dealers everywhere. Insist on SIGNAL—it's *your* protection.

SIGNAL Vernier Rheostat



You'll surely approve of this SIGNAL Vernier Rheostat. It has the fine appearance and will give the exceptional service which characterizes every SIGNAL item. It's the first successful vernier using a single knob for control. Fine adjustment easily obtained. Furnished with or without knob and pointer, so dial to match others of set may be used.

The coupon below will bring you valuable and practical information—if you send it in right away.

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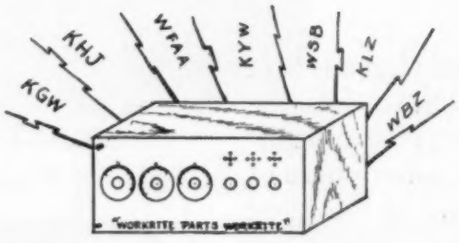

Catalogue No. 195 Amplifying Unit.....$7.50
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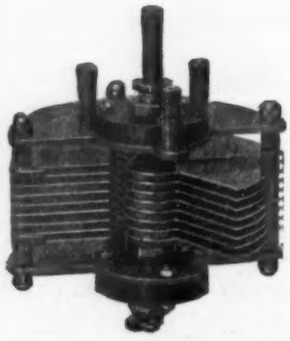
Molded Bakelite



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$4.25
Cap. .00035 m. f. 17 plates

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Continued from page 50

face of the caps of the 'phones should be smooth and durable. This is the only insurance against skin abrasion and discomfort.

The cord of the 'phones should be between 5 and 6 feet long and we must not fail to ask the clerk to see the interior of the headset that we buy. We should make sure that the interior parts are protected from moisture and from possible mechanical damage. It is well to actually listen in with the 'phones to determine the quality of the reproduction. We must not forget that it is possible for 'phones to do their share of distorting.

What holds true concerning 'phones also holds true with many loud speakers. The best way to buy a loud speaker is to listen to it, and if possible compare it with other loud speakers. That is the best way to determine tonal qualities. Of course, if quantity and not quality is wanted, that is another matter.

Little can be said about amplifying transformers of either the radio frequency or audio frequency type. The best we can do is to buy the product of reputable manufacturers and make sure that the insulation is sufficient. If the binding posts are mounted in metal let us see that the bushings are made of something better than fibre.

The matter of aerial plugs for lighting circuits deserves some attention. If there is one nice way to start a fire or to get a dangerous shock, it is through a carelessly constructed plug. There are still plugs in the market containing paper condensers. They are dangerous and should positively be avoided. When we buy such a plug we should insist that it contain a mica condenser.

With the multitude of complete sets that we now have on the market the purchase of one of these is indeed a problem for a beginner. The writer would never purchase a complete outfit without first being allowed to hear it. Hearing is believing. We should also have the dealer demonstrate to us how sharply the outfit tunes and if interference can be eliminated to a reasonable extent. If the outfit has over two stages of audio frequency amplification we should not even waste our time listening to it, since engineers have long since proven that it is impossible to reproduce clear, distortionless speech or music by the use of more than two stages of this sort of amplification.

In the case of the individual instruments in the outfit, let us examine them carefully to see that they have all the desirable features outlined heretofore. Will the panel warp? Is it thick enough? Will the dials warp? Are all of the connections carefully soldered? Is the panel shielded to prevent howling? Is there any possibility of short circuits through crossing wires?

Mother enjoys the programs because of Frost-Fones

"I PREFER my Frost-Fones to any others I have tried because of their almost human tone. Then too, they never tire my head, even after I have listened to the radio programs for hours. They are easy to adjust, do not muss my hair, and are so light and comfortable I wonder why every woman does not insist upon Frost-Fones." Thousands upon thousands of feminine radio listeners have discovered this for themselves. In addition to clearness and comfort in Frost-Fones, they appreciate the thrift-advantage offered by Frost-Fone prices.

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In the picture above is illustrated the famous Frost-Radio Receiving Transformer which retails for $8.50. Examine this fine piece of apparatus at your dealer's today. Mahogany-finished hardwood base and frame; Viscolac impregnated tubes; silk-covered wire wound; polished Formica secondary coil head; all metal parts nickel plated and hand buffed. Range: 200 to 4000 meters. Works wonderfully well on either crystal or tube set hook-up. Order one from your dealer today.

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Price
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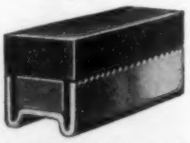
YOU know how important it is that your receiving set be safeguarded by an "approved" protector. Underwriters require such protection.

The best of all protecting devices for radio use is a Frost-Radio Protector. It is made by telephone engineers who have built *practical* protectors for telephony and telegraphy for many years. The Frost-Radio Protector has been approved under new rules as revised May, 1922.

Order from Your Dealer

Order a Frost-Radio Protector today from your dealer. Note the patented sawtooth construction of the elements, which makes the protector positively self-cleaning. Note also the sturdy, simple, fool-proof construction. When installed on your aerial you can forget entirely the hazard of atmospheric electricity.



Note the close spacing of protector elements in accordance with new rules

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Interesting Proposition for Dealers

European Radio Company
1342 East 22nd Street Brooklyn, N. Y.

A VERY USEFUL RECEIVER

Continued from page 23

she is at a distance!" chuckled the newcomer, as he sat in a deck chair: "Keep her up nicely!"—he added—his eyes running a' low and aloft.

"She aint fancy—but she's not too *on*sprightly—at that!" Thad' filled his pipe slowly. "And what can I do for you?"

"Ever try any motion picture work?"

The skipper shook his head negatively, as he puffed, match blazing between his fingers.

"How would you like a week's charter—off shore?"

"How far—off' shore?"

"Oh—just out of sight of land. I'm directing a sea story for the Perfect Film Production Co.—and the yarn calls for a rescue at sea—and that sort of thing.

"Wull there be ony *weemen* on boarrd?" queried the little chief—anxiously.

"Only the principal—Miss Margie Ferguson. Heard of *her*, haven't you?"

"I kenned a *Janie* Fairrguson—back in Dundee—but I'm doobtin' t' is the same one."

The visitor laughed—"Hardly! This Miss Ferguson is one of our best-known 'stars'."

"If we make a deal, Mac, either you or I'll have to give up our quarters to the lady!" Thad' announced—slight perplexity in his tones.

"For Sainty' sake let it be *you*, then! For I'll nae have on'y *fee*male in my cabin! T'wad smell like a—like a—a *pairfumery* shop—for mony's the day after, and the *pairfume* o' actrrresses is nae guid for the peace o' a quiet engineerr's soul!" said the little Scotchman grimly.

Whereat the visitor whooped in glee!

"Mac's alright"—the skipper grinned—"but I believe he'd ruther have sand in his engine bearings—than skirts on board!"

"True'r worrd was never spoken! They're oncanny beasties! Juist like a flea!—ye never can be cerrtain which way they'll hoppit—*next!*"

"I can promise you that you will—I was about to say—fall in love with Miss . . . . . ."

But the visitor got no farther! The little chief popped up as though he had been stung—"Hoots-toots, mon! An' wha' arre ye sayin'? Me—*in love?* Ye mak' me blush at the vera thought—aye!" And off he went—disappearing aft.

"Then everything is satisfactory, Skipper?" Director Harry Thomson—for as such he had introduced himself—shook Thad's hand at the gangway.

"OK with me!"

"Right!—We will come on board tomorrow morning at about ten. You will have steam up—and so on?"

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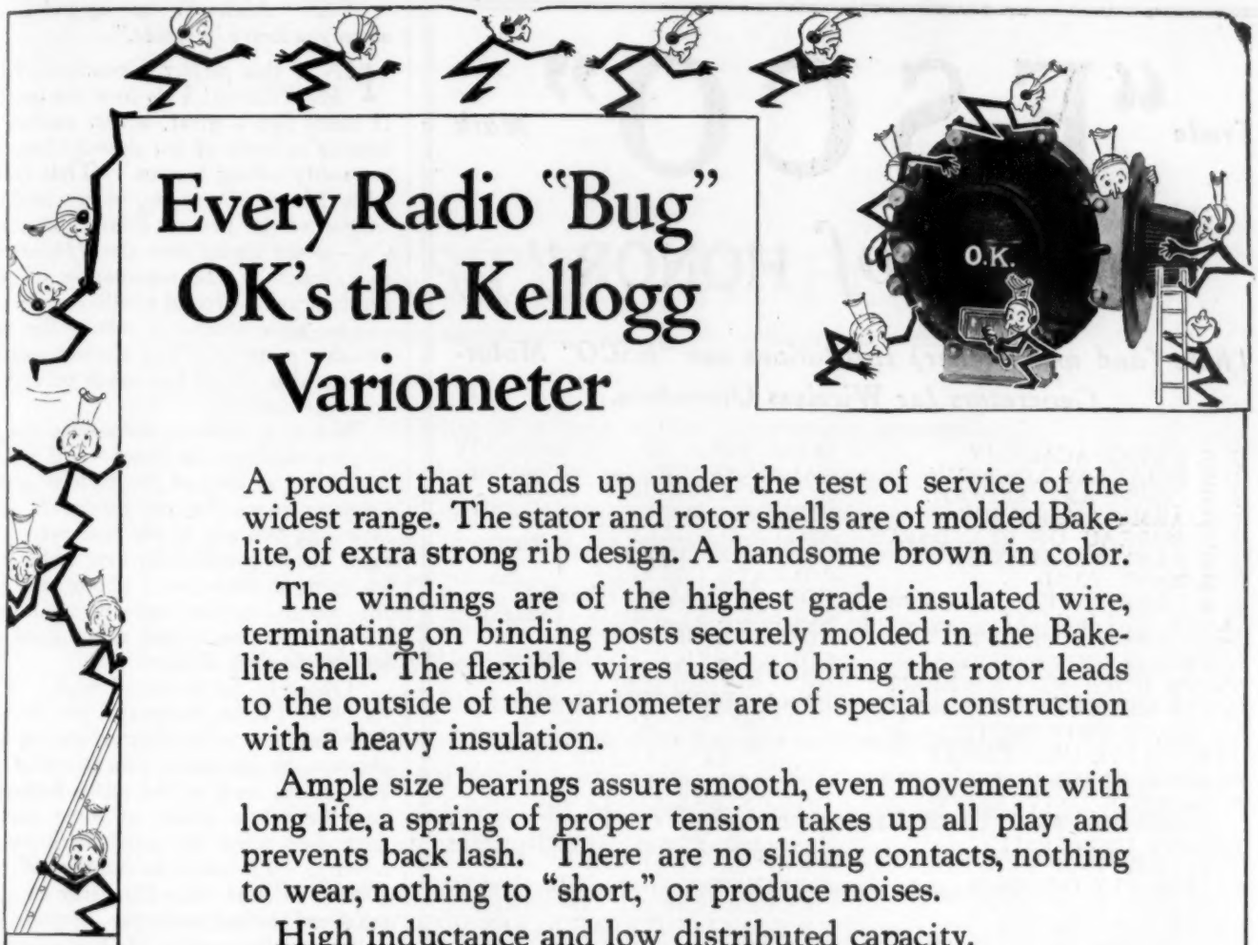

Every Radio "Bug" OK's the Kellogg Variometer

A product that stands up under the test of service of the widest range. The stator and rotor shells are of molded Bakelite, of extra strong rib design. A handsome brown in color.

The windings are of the highest grade insulated wire, terminating on binding posts securely molded in the Bakelite shell. The flexible wires used to bring the rotor leads to the outside of the variometer are of special construction with a heavy insulation.

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High inductance and low distributed capacity.

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Get the most out of radio. Build it with Kellogg time-tested equipment. Use the following KELLOGG radio equipment for better results:

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Write for new Bulletin 237A

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Special Apparatus Developed for Special Purposes.
Motors, Dynamotors, Generators, Motor-Generators.

Continued from page 54

"OK! Anchor'll be up-and-down when you heave 'longside."

"ISN'T this *perfectly* beautiful, Mr. McWilliams! I *do* love the ocean! It seems like a great, tender mother—bearing so many of her ship-children on her softly rolling bosoms." Thus spoke Miss Margie Ferguson, yclept leading woman of the Perfect Film Production Co.—as she leaned over the *Aphrodite's* rail, watching the sun-sparkle of the gently-heaving ground swells.

The little chief—in whom the undeniably pretty girl had already excited feelings that caused him *much* perturbed concern—nodded.

"But as a mitherr, she's unco rough wi' her children—at times—ye'll ken!"

"It was *so* kind of you to have given up your room, for my comfort!" She looked at him out of big blue eyes, and from 'neath wonderfully-long lashes. "I am going to leave you a photograph before we go—so that you will not forget me—and you *must* come, as our guest, to see the finished picture!"

"Oh-aye! To be sure I wull! T'is na likely I'll be forrgettin' ye—soon!" (He had gone in his quarters during her absence—to get some tobacco—that he kept in the back of the settee locker—and the subtle aroma of some dainty scent had filled his mind with much unrest). "I'll hae to be fumeegatin' wi' a bit o' sulphur—else I'll *never* be able tae sleep!" he had muttered—stepping on deck again, hurriedly. He had also seen bits of white-laced things hanging about. Soft, frilled things—silk, he opined!

And he was greatly disturbed in soul!

"Oh-aye! T'is gratefu' I'll be for the photograph—maist certainly!"

Director Thomson came up at that moment—"I think that we will shoot a few deck scenes, Miss Ferguson. Those where you and Brown are shown talking in a friendly way—you know—he registers beginning to fall in love with you—and so on."

"I'll have my make-up on in half an hour."

"WHY dont you carry a wireless?" asked Frank Lewis, the camera man—of Thad', that night at dinner.

"What's the use of the expense? The outfit costs a lot, and I'd have to ship somebody to work the thing. Mac' and I are too old to break in on *that* game. We dont need it—anyway—carryin' no passengers—and all 'long shore work."

"Mind If I rig up a wire between your masts? I've got a little outfit with me—just to listen-in with, of course. Made it myself—and I'd like to try it out here."

"Help yourself!" replied the skipper—genially.

All the next day the *Aphrodite* rolled

Continued on page 58

WASTED EFFORT

The building of a radio set is absorbingly interesting.

The prime motive actuating men and boys of all ages in assembling their own receivers is the realization that only by so doing can a practical knowledge of radio telephony be acquired.

Thus, the different circuits and functions of the various parts are better understood.

Heretofore, much tedious labor has been involved in the undertaking. Laying out the panel and the drilling of from forty to eighty holes, as well as the mounting of tap-switches and soldering of primary leads, have all contributed to making the job a laborious one.

Eisemann units and panels eliminate more than half the labor ordinarily required.

All units are simply attached to aluminum panels with screws and nuts. All panels are completely drilled. Several sizes of panels are offered, with openings provided for any number of units that may be desired. The panel, itself, acts as a perfect body capacity shield. The vario-coupler is complete—a tap switch being carried inside the rotor.

Before starting to build a Receiving Set, it will be found worth while to examine Eisemann radio products.

Descriptive literature on request.

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William N. Shaw, *President*
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DETROIT CHICAGO SAN FRANCISCO

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The Best Headset

Highest Audibility
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Aluminum cases—6 Foot cord—Weight 12 oz.
Type 6-A 17500 Turns (2200 ohms) Hard Rubber caps.....$7.00
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If your dealer does not carry them he will order them for you. : Dealers and Jobbers Write For Discounts

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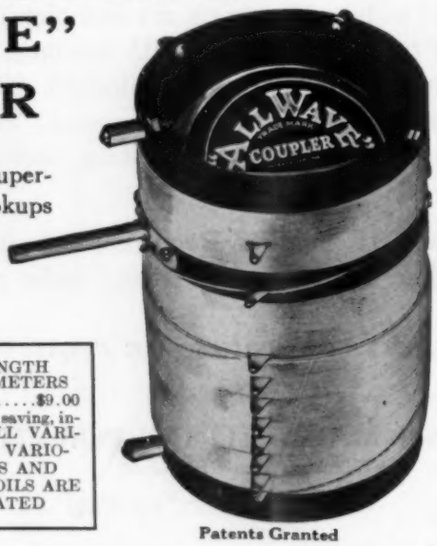
DX STATIONS LOUD AND CLEAR

WITH THE GENUINE AND GUARANTEED

"ALL-WAVE"
(Trade Mark)
COUPLER



And anyone of the Six Simple Super-Sensitive Single Circuit DX Hookups
GIVEN FREE
with each Genuine and Guaranteed "All-Wave" Coupler

It is an established fact that anyone of the simple Single Circuit hookups used in conjunction with the Genuine and GUARANTEED "ALL WAVE" COUPLER will bring in "DX" stations louder and clearer than any double circuit can.

WAVELENGTH 150 to 3000 METERS
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1/8" thick, per square inch.....01¾
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PROMPT SERVICE—POSTAGE PREPAID
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P. O. BOX 596, REEDLEY, CALIF.

Tell them that you saw it in RADIO

Continued from page 56

easily along, under bare headway—on a quiescent sea—out of sight of land—while various scenes were shot. Much gaity prevailed and both the skipper and the chief became greatly interested in the picture making.

"Yon's mighty like the *real* thing!" the little Scotchman muttered to Thad', during the making of a love scene between the girl and her male support.

"Not *jealous*—are you—Mac?" suggested Thad'.

"Eh — *ME!* Mon! — 'tis fulish ye arre!" retorted the other. But he did not like to see the girl "pawed ower, by yon' bruiser!"—as he expressed himself anent the leading man.

"HEAR anything?"

They all sat on deck in the brilliant moonlight—the heavens a'drip with stars—while the gentle *'plash* of disturbed waters came from the shadows over-side.

"Lots of ships—working—sending messages to shore—passenger lists, and so forth—" answered the alert camera man, 'phones over his ears. "Here—listen—" he passed the head harness to the skipper.

"Sounds like a lot' o' squawkin' and scratchin'—to me!"

"Wait a minute!" The other tuned about a bit, the faint glow of the detector and amplifier tubes showing redly through the little ports in the receiver case—"Listen to that!"

Again Thad donned the 'phones.

"*Music*—by gosh!" he ejaculated.

"Sure! That's from the big Newark broadcasting station—fine—eh?"

They all laughed as the skipper's toe began to beat time to the tune that he was hearing.

An the chief must needs listen—too.

"How much for a contraption like that?" asked the skipper; "be fine to have one on board—eh, Mac? Reckon you could run it?"

"Easy!" interrupted the camera man. "A child can operate this set—lots do! Cost you about $125—with a storage battery complete."

"*Lot* o' money!" said the chief—solemnly.

"Guess I'll blow the ship to one—out of my share of the charter—" Thad laughed.

They listened, in turn, to the music for a time—and then, one by one—said goodnight.

"I'll stay up a while longer—want to experiment a little"—announced the camera man, and presently he was alone in the moon splendor, the tubes glowing eerily from their black caverns. His body registered intent listening. He turned the receiver dials this way and that—very carefully. Minutes passed. From time to time he looked at his watch by the aid of a vest-pocket flash light. Suddenly his fingers stopped. For an

Continued on page 60

Which One Do You Want?

USE A

WORKRITE

Super Vernier Rheostat and the WorkRite Tuner Team

and you can tune in on the station you want even with your local station in operation

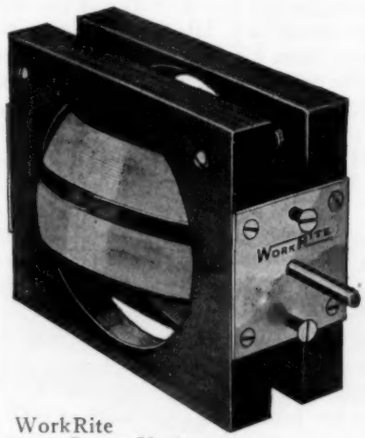
50,000 Adjustment Vernier Rheostat

Here is an instrument that is the last word in Rheostats. 50,000 adjustments for $1.00. The drum is moulded and can not shrink. No danger of the wires loosening. Easy to mount on panel. Pushing the knob way in turns off filament. Turning the knob gives the very finest adjustment. Often a turn of 1/32-inch will clear up a station or separate two stations. The regular Rheostat has 6 ohms resistance. A WorkRite Super Vernier Rheostat on your Detector Tubes will double the efficiency of your set. Try it and see. Put a WorkRite Rheostat on each of your tubes and get perfect adjustments.

WorkRite New Super Vernier Rheostat $1.00

(With 15 ohms resistance, $1.10)
(With 30 ohms resistance $1.25)

WorkRite 25 Ohm Resistance Cartridge for use with any 5 ohm Rheostat for controlling UV 199 Tubes.....40c



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Super Variometer

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Tunes Out Local Stations and Gets the Station You Want

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Double the life of your battery by giving it proper care. Fill and test it regularly with a WorkRite Hydrometer. Never let it get below 1150. Full instructions for testing and care of battery with each "WorkRite." Get one now.

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Loud Speakers complete with phone unit and cord.
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Complete switch set in one unit. Parts made to work together. Use block for template in drilling plate. Price..... **50c**

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Extremely sensitive and free from distortion. Compare it with any on the market.
New Price **$6.00**

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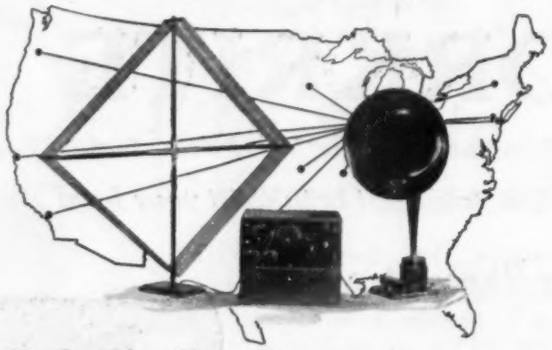
Range, Volume, Portability With a Single Tube!

Any receiving set is vastly improved by Erla transformers, covering a wave-band of 200 to 800 meters. TypesAB1,2,3,$4.Reflex,$5



Erla Reflex Transformers Assure This Result

Vacation time holds new and untold pleasure, when you tune in with Duo-Reflex, the most powerful single-tube circuit ever built.

Through a loud speaker, it brings in all but the most distant stations; and with headphones it ranges from coast to coast. Its light weight, less than fifty pounds, with dry cells, makes it ideal for camping trips or week-end tours.

Interference and static disturbance are conspicuously absent. Even in hottest weather, clear and perfect reception is assured.

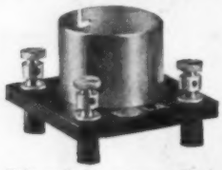
Responsible for the amazing efficiency of this circuit, and the secret of its power, is the Erla radio frequency reflex transformer. Overcoming completely the high capacitance of domestic vacuum tubes, and with lowest inherent capacitance, it provides maximum amplification without distortion.

Everybody can afford Duo-Reflex! Because of simplest construction, it costs considerably less to build than other circuits of comparable range and volume.

Your dealer will gladly present you with a copy of our Bulletin No. 13, giving diagrams and precautionary notes covering its assembly. Or write us direct.

Erla bezels, in 1" and 1¼" sizes, are finished in polished nickel or dull black enamel. Telescoping rim fits any ⅛" to ¼" panel. List, 20c

Erla fixed condensers reveal markedly superior accuracy, being exactly calibrated and individually tested. Made in eleven sizes, 35c to $1 each



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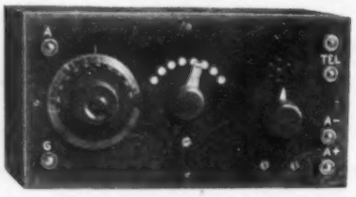

Wiraco concert receiver

Receives concerts up to 1000 miles. Compact arrangement makes an ideal set for camping trips; complete with 301A tube, batteries and phones, $33.50.

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BROADCAST PROGRAM

A weekly magazine devoted to Western Broadcasting.

5c per copy.
26 issues for $1.00.

BROADCAST PROGRAM
449 Pacific Bldg.
San Francisco, Cal.

Continued from page 58

instant he was motionless. Then he took a sheet of paper from his pocket, laid the light on deck, switched on, and by its bright circle of light—wrote, hurriedly.

Herewith the text which he took from the air—after the usual message preamble—number of words—check—etc.:

To *Perfect Productions Co. Studios, Bronx, N. Y. City. Arriving Thursday expect to pass Sandy Hook Lightship about 3 afternoon everything satisfactorily arranged.*

Sig.

Mathews.

The camera man read it over after he had finished—and chuckled—"That's *that!*" he said to himself—switched off the tubes, disconnected the storage battery and carried the apparatus to the chartroom—where he bunked, on the wide settee.

THE director and the girl read the copied message—that the camera man slipped to them, unseen by anyone else—the next morning.

"*Too* easy!" said the director—softly—and the girl laughed. "Day after tomorrow afternoon—that will be, eh?"

The camera man nodded.

"I'll hop up and see His Nibs!"—going to the rail the director let the message—now tiny bits of torn paper—flutter from his fingers. Then he went on the bridge—where Thad' was pacing backwards and forwards—on his morning "constitutional"—as he called it.

"I've been thinking it over, Skip', and I'd like to get a scene showing the passing of a big liner—water foaming at her bows—smoke rolling from her funnels—wash of her wake—and so on—you know. This story does not call for it, but it is a good opportunity to catch some liner or another—in-coming to New York and get close enough to shoot a couple of hundred feet—or so—to have for future use. How about it?"

"Easy enough!" Thad answered. "We're about a'breast of Long Island, and some 60 miles off shore. If you say so we can mosey along down toward the Hook—get right in the fairway of all the liners—no fog at this time of the year—and I'll put you close to some big fellow."

"A cable reached me, from a friend, that he is coming by the *Catonia*—she's due in New York day after tomorrow—late afternoon, I believe. Do you suppose that we can pick her up as she comes in?"

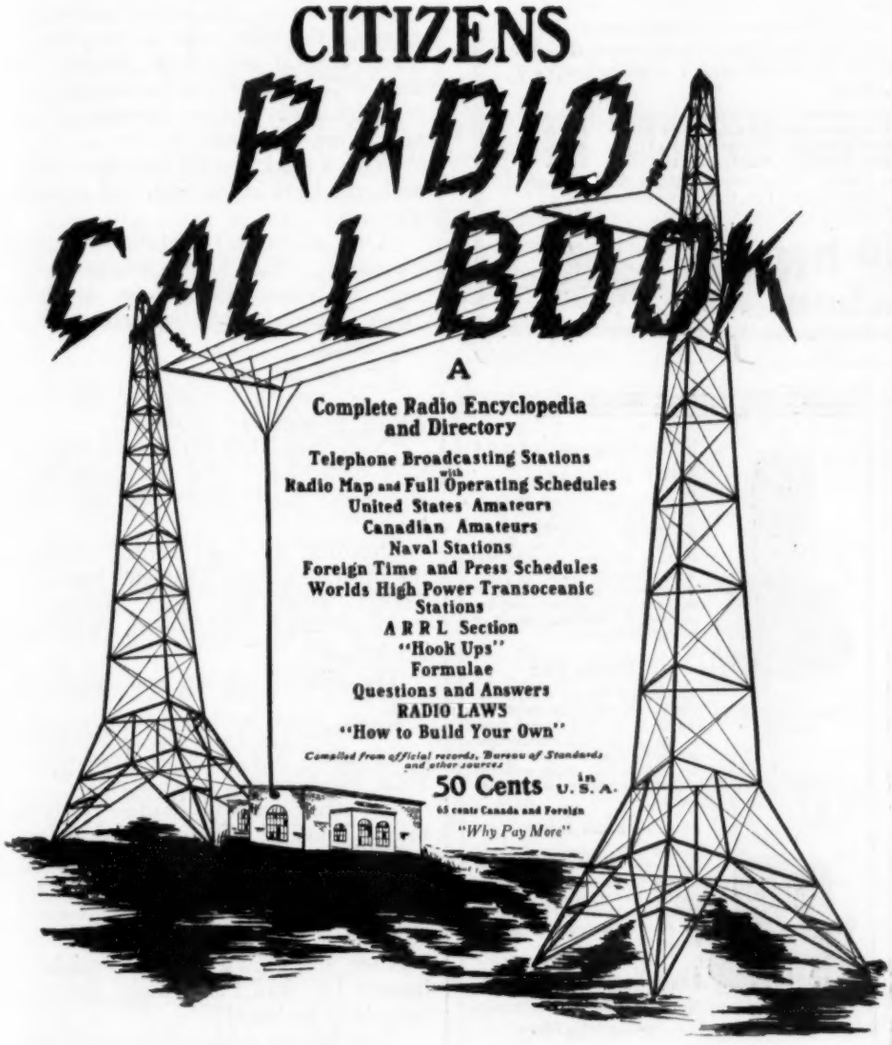
"Can't very well miss her!" grunted Thad—"'bout the biggest thing a'float! We'll head that way, while you go on with your picture making—st'rboard two points!"—to the squat quartermaster at the wheel—

Continued on page 62

JUST OUT!

The Latest Edition of CITIZEN'S RADIO CALL BOOK

180 Pages. Only 50 Cents Per Copy



CONTENTS

The Nine Amateur Districts, Special Amateur and Experimental Stations. All practical wireless circuits. Schematic diagrams of these and a glossary or description of the working of the circuits. There are also full page graphic illustrations and photographs of the Flewelling circuit, the Reinartz and Armstrong double regenerative circuits.

A complete list of all Telephone Broadcasting Stations with their full operating schedules. These are also listed alphabetically by States. A complete 4 page American Radio Relay League section, containing a letter to the Citizen-Radio, by Mr. Kenneth B. Warner. A double page A. R. R. L. divisional map. A page giving the personnel of the Executive and Operation Divisions throughout the country.

A complete list of all Canadian Amateurs and Canadian Telephone Broadcasting Stations with their schedules.

A double page Radiophone Map of the United States, with all stations marked on the map, drawn to scale.

A double page map of the world, with all high powered stations marked. A Complete Schedule over 24 hours' time (Greenwich) of all high power stations, time they send, system they employ, wave length and character of the matter they send.

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International Continental Code and Conventional "Q" Signals.

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Up-to-date Radio laws, Amateur and Commercial.

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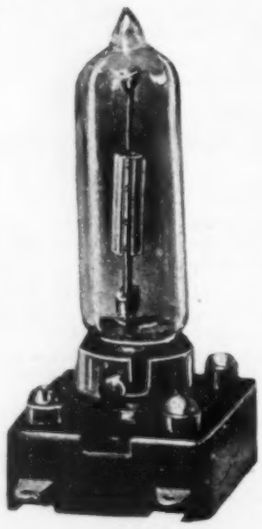

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Continued from page 60

"St'rb'rd—two p'ints—sir!"

An the *Aphrodite* plugged evenly along on her new course.

FELIX MATHEWS—or, so listed among the *Catonia's* cabin passengers—paced along the liner's vast deck. Immaculate in blue serge—white shoes—a slight angle to his yachting cap—he was followed by several pairs of feminine eyes, for he had been the life of the gayer set, during the swift voyage.

As he turned the for'ard corner, to cross to the other side of the ship, a quietly-dressed little man touched his arm—"Could I see you for a moment?"

"Certainly! But you have the advantage of me, my friend!"

With a quick motion the other threw aside the lapel of his coat, and a badge gleamed.

"Oh! an officer!" Mathews smiled pleasantly. "Can I assist you in ferreting out some crime?"—he laughed. "Come on in the smoking room—this is interesting!"

He lead the way.

"*Very* smooth!" whispered the little official to himself—following.

"Now then—but before you begin—have something? We are approaching the driest land under the sun, you know!"

"Nothing for me—thanks!" replied the other, watching Mathews keenly—"What about the pearl necklace—*Thomas?*"—he asked—with startling abruptness.

The other's face did not change an iota.

"'Thomas'? You must have made a mistake! My name is Mathews—Felix, given name. Have a cigar?"

The officer shook his head—"Nothing to it—Thomas! It wont do! Very neat, and all that—but your smuggling days are over, old timer! Come clean with that pearl necklace that you bought at Varennes & Co., Rue Lafitte, Paris! You see, I've got the dope all straight—haven't I? And I also *know* that you brought it on board!"

"Searched my cabin—have you?" still there was laughter in the self-styled Mathews' voice, tho' his eyes were shrewdly hardened.

"Of course I have, and I give you credit for not keeping it *there!* But I promise you that you'll never get it ashore illegally! From the time that we strike quarantine, *I'm* going to play shadow to you, old man, so better give up, and I'll see what I can do with the chief—that is, IF you do not declare it, of course!"

"But my dear sir, I assure you that I am *not* . . . . . "

"Cut that out! I suppose that you will deny the diamonds and sapphire's clever little trick—two years ago—also, huh? That time you hid 'em be-

hind a panel in your cabin—then went calmly ashore—came back, disguised as a carpenter, working on the ship, two days later—walked safely ashore with the stuff, and when *I* came along all that I found was the empty hole—as neatly made as any first-class joiner could have done it! You're *some* artist! But this time that stunt doesn't pass muster!"

"Really, sir—you are insulting! I shall appeal to the captain for protection!" the immaculate man got angrily to his feet.

"As you like—Thomas!" the plain clothes' man replied—gently. "I've got nothing on you—*yet*—but just *try* to get that necklace ashore by smuggling it—that's all!

"I suppose that you are going to dog me all over the ship!"

"Not yet! No fear of you're tossing it overboard. But when we slow down for quarantine you'll find me Johnny-on-the-spot!"

The officer watched the other stride from the smoking room—and he chuckled—ordering a ginger ale and a cigar.

NO one noticed a man, in the uniform of one of the *Catonia's* sailors—busy at something—by the taffrail of the big liner, nor did anyone see a little wooden box—about two feet square, tightly nailed—slip from his hands into the foaming pother of gigantically-churned waters, under the steamer's stern. And no one noticed him wave his hand at a little freight vessel, that lay—nearly motionless—not far away, and on whose bridge a motion picture man cranked at his camera. If these things had been noticed—they would have been thought mere greetings. Everybody waves when ships pass one another—close alongside!

. . . . . .

"Did you get her—alright?" inquired Skipper Thad' of the camera man.

"Surest thing you know! Light could not have been better!"

At that moment the director came on the bridge of the *Aphrodite*.

"All serene?"

"Fine!"

"Hello! What's that—floating, over there?"

The skipper reached in a covered case, fast to the bridge rail and took therefrom a pair of glasses—looked through them—"Box been hove overboard by the stewards, I reckon. They're cleanin' up ship—for port."

The director seemed to think for an instant—

"I've got another idea!"—and he laughed—"Can you lower a boat? I'll have Miss Ferguson get in an old wrapper—or something. We'll row over, put her in the water, let her be hanging on to the box—and shoot a few feet of it—call it *'kept afloat by a box of food, and yet starving!'*—meaning that she is clinging to the box for her life, that has food, but which—of course, she cannot open. How's *that* for a scene?"—to the camera man.

"Great stuff!"

"Sure—no trouble to lower that dingy of ours!" The skipper swung the engine room telegraph to stop—then gave the necessary order for the lowering away of the boat.

He and the chief watched the shooting of the scene—that was life-like in its reality. The girl, in a kimono, was slid in the water from the small craft. She wet her hair and dragged it about her face. Clinging to the box with both hands she made a most excellent portrayal of the situation.

And when the shooting was over she insisted upon having the box—"to keep as a souvenir of having saved my life"—as she laughingly expressed it.

PROTESTING most forcibly—telephoning for his lawyers—Mathews—sometimes known as "Thomas"—stormed about the customs' officers' rooms on the dock.

"A cursed *outrage!* Tear my baggage to pieces—search me as tho' I were a pickpocket—delay me here for hours—and all for some infernal cock-and-bull story about a 'necklace'! You are a wonderful pack of sublime *idiots!*"—this to the gathered Officials.

And—finally—they had to let him go—after the most grilling examination that first class passenger ever had—and after his cabin had been prodded and thumped and pounded by a master-carpenter—who, however, reported that he could find no signs of anything having been tampered with—in the woodwork.

WITH many cheery "good-bye's"—the girl, the director, the leading man and the camera operator left the *Aphrodite* at Providence. The skipper and the little chief both promised to attend the opening night of the picture, as soon as the girl advised them of the date.

"Say—Cap'—"—the camera man had said, prior the coming to anchor—"I'll give you that receiving set of mine. You know how to work it now—and the company is rich enough to pay for another for me. I'll chalk it down to 'expenses'—or 'lost overboard'. It has been a most useful receiver to me—I've learned a lot from it!"

And Thad' had accepted the gift with alacrity!

They were gone. And on the chart-room table lay $500 in $20 bills.

"Not so bad, eh—Mac'?"

"No sae wairse!" the other agreed. "But yon *pairfume* in my cabin is na good for the soul o' a pecefu' Engineerr!"

TWO nights later:

At a charming little bungalow, tucked away in the hills of Westchester

Continued on page 64

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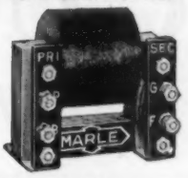

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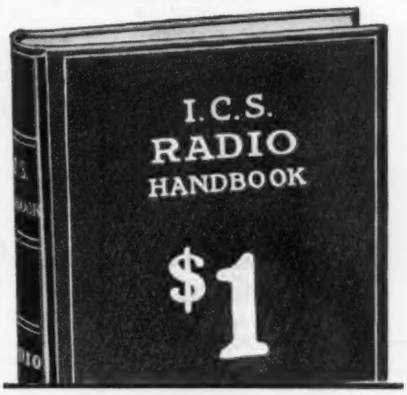

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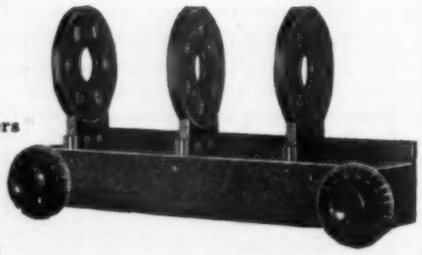

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Continued from page 63

County, not far from New York—sat the "director," the girl and the "camera man."

Lying on a pad of black velvet, with a single, shaded, electric light shining on it—was a marvelous necklace of pearls—perfectly matched in color—and graded in size with wonderful precision.

"They'll clear us $80,000—very nearly!" said the "director"—softly.

"Not a bad few days' work—at an outlay of $500, plus a very useful receiving set!" and the camera man laughed.

"But the little Scotchman *was* a dear!" said the girl. "I poured all my expensive scent in his mattress—because he was so afraid of the influence that it might have on him!"

The three watched the papers closely, for some hint of the "story," but the Customs—knowing that they had again been cleverly duped—held their peace.

"I'll bet anything you like that radio had something to do with it—*somehow!*"—assevered the officer who had tried to catch "Thomas" in the act.

The others shrugged their shoulders —"Maybe!"

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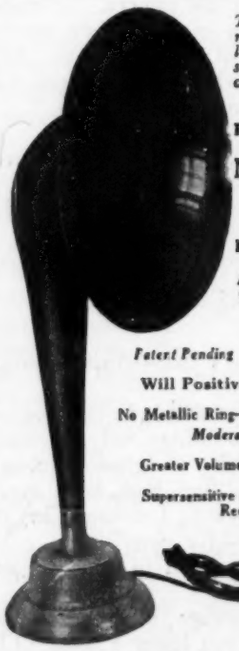

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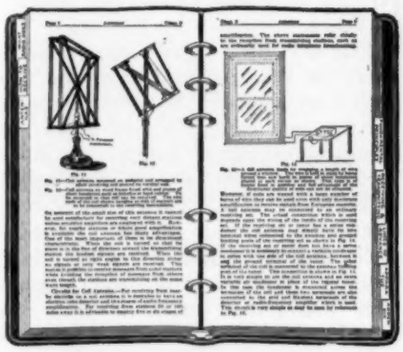

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SINKING OF THE IOWA

Continued from page 10

and by noon had joined the *Iowa* and her controlling ship, the *Shawmut,* some sixty miles south of the canal entrance. Each ship assumed its previously assigned station upon signal from the Commander-in-Chief—the *Pennsylvania* and *Arizona* directly astern of the *Iowa,* with the fall of shot observers and official camera party on board, followed by the *California* and *Maryland* with the Secretary of the Navy, a host of senators and congressmen, and many others, including high ranking officers from both the Army and Navy, on board as observers.

On the firing line which maintained a range of from seven to nine miles from the *Iowa,* and barely visible to the eye, were the dull grey hulls of the *Mississippi,* the firing ship, and the *Nevada* with another party of observers on board.

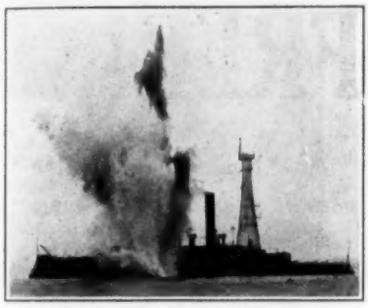
Promptly upon signal from the *Maryland,* the red powder flag of the *Mississippi* went smartly to the yardarm and her five-inch battery blazed away with almost unbelievable rapidity. An inspiring sight it was, to see these shells strike, burst, and send wreckage of every description high into the air. From the shells that were not direct hits, large columns of water arose, and many of these found their marks as they ricocheted out of the water and into the hull of this famed old ship. Occasionally, huge clouds of smoke shot out of the hatches of the superstructure deck, signifying that a shell had exploded inside after having pierced the unarmored portions of the ship.

Upon the conclusion of this run, and after an inspection of the damage wrought by the five-inch battery was made, the second run was made. Here, the gunners behind the monster fourteen-inch rifles had an opportunity to show their skill. The first salvo of six guns sent over four tons of steel thru the air on its mission of destruction, and as the huge columns of water went skyward upon the fall of this salvo, and completely extinguished the target ship from view, the accuracy of the gunners and control personnel on the firing ship was proved. The spectacle which followed as a result of fifteen additional salvos will never be forgotten by those who witnessed it. Huge holes were torn in the sides of the ill-fated target as havoc followed in the wake of each hit. Notwithstanding this gruelling punishment, the magic ship steamed steadily onward, or zig-zagged—all this amid a hail of steel.

An examination of the extent of damage was made upon the completion of this run, which revealed that the *Iowa* was in a sinking condition as a result of so many penetrations below the water line, and it was decided to delay the

firing until the following day. In the meantime, mats were rigged, weakened bulkheads were shored up to prevent the water from pushing its way from one flooded compartment to the next, and many fires which followed the explosions of shells within the ship, were extinguished.

Eleven o'clock on the morning of the second day found the *Iowa* in her assigned position and under the guiding hand of the controlling ship. Shortly after opening fire, a noticeable list to port gave evidence of serious damage. One salvo, exploding within the ship, had folded the quarterdeck upward and back toward the after mast; another, striking the base of the forward stack,



—*Photo by A. E. Wells*
The Effect of One Salvo

had carried it away, together with a large portion of the bridge structure. The turrets, which formerly carried twelve-inch guns, were completely wrecked. Three direct penetrations of the armor belt, close together, practically demolished the entire amidship section of the ship and set fire to all inflammable material in the vicinity.

It was certain after this run, that the ship was fast sinking and that the damage was beyond repair. The list to port was increasing, and it was decided to continue with the exercises as originally planned.

The third run was begun, and almost coincidently with the landing of the ninth salvo, the *Iowa* listed over heavily, paused, and soon rolled over on her side. Here she paused again as if determined not to give in to the inevitable—her bow rose up as if to signal a farewell to the fleet of modern superdreadnaughts which now surrounded her, and she passed from view.

The Development of the Radio Control

IN the fall of 1919, the *Iowa* was allotted to the Bureau of Engineering of the Navy Department as a result of a proposal made some time before, the purpose of conducting some experiments based upon the control of war craft from a distance by means of radio. In conjunction with the U. S. S. *Ohio*, many experiments were conducted in the waters of Chespeake Bay during the following two years—the ideas of a

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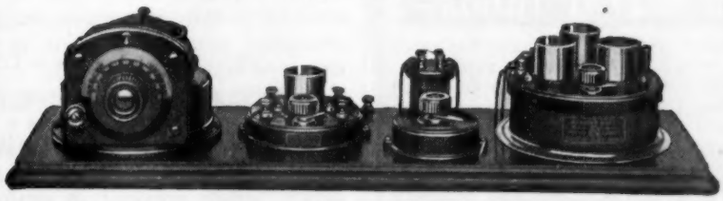

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number of inventors were tried; many were accepted and a like number were rejected. A method of control developed by one leading experimenter proved unsuitable because of its susceptibility to signals caused by almost any electrical disturbance on board, such as a sparking commutator, or the opening and closing of a contactor switch. This particular system required the use of super-sensitive amplifiers and relays which also made it subject to the effects of vibration and mechanical shock. And it is said that even the vibration caused by loud conversation in the compartment in which the apparatus was installed often caused the ship to put on right or left rudder and move accordingly.

Most of these systems lacked the necessary ruggedness and so the responsibility for developing the finally accepted method of control fell upon the Navy Department. The secret nature of this system makes it impossible to dwell upon details here. However, it may be said that the apparatus which maneuvered the *Iowa* as well as by a full crew, and which continued to do this long after any human being could have existed on board, until she was reduced to a mass of wreckage by the terrific gunfire to which she was subjected—was susceptible only to the signal intended to operate it, and was not subject to the shock from even the highest explosive shells, many of which exploded within only a few feet of the remodeled powder magazine in which the apparatus was installed.

Probably the most interesting part of the controlling equipment was a device very appropriately termed "the mechanical quartermaster." By means of this device, which operated in conjunction with a gyroscopic compass, the ship could be steadied and held upon a designated course simply by sending the necessary signal. Throughout the practice, this apparatus functioned perfectly — the *Iowa* was held upon a steady course, turned, or zigzagged at will in an effort to evade the accuracy of the gunners on the firing ship.

Three separate and distinct antennae, any one of which could be shot away or otherwise damaged as by grounding, were used to make the control positive.

GO to your rest, *Iowa!* We loved every particle in your steel hull and every plank in your deck! Helpless, yet with your colors flying, slip your cable and sail for that haven of rest and peace you deserve, bedecked with honors won, beloved by all, revered by all for the standard of service you have set for us! Faithful to the end! We bow our heads and stand at attention while one of your fleet mates punctuates your swan song by a great national salute.

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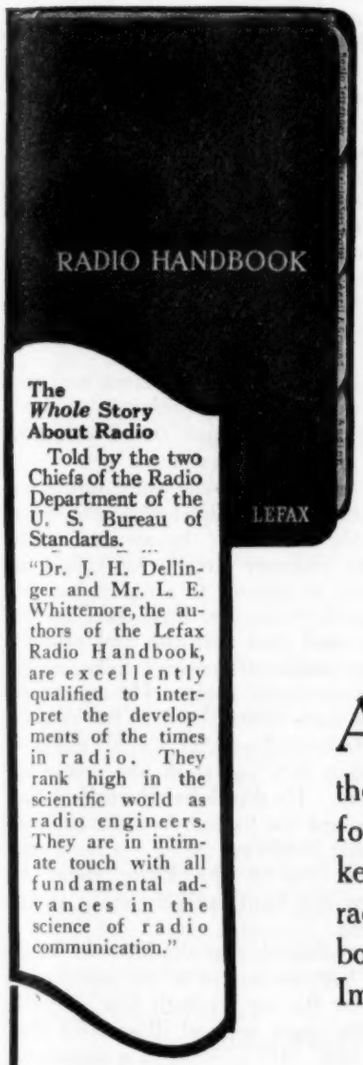

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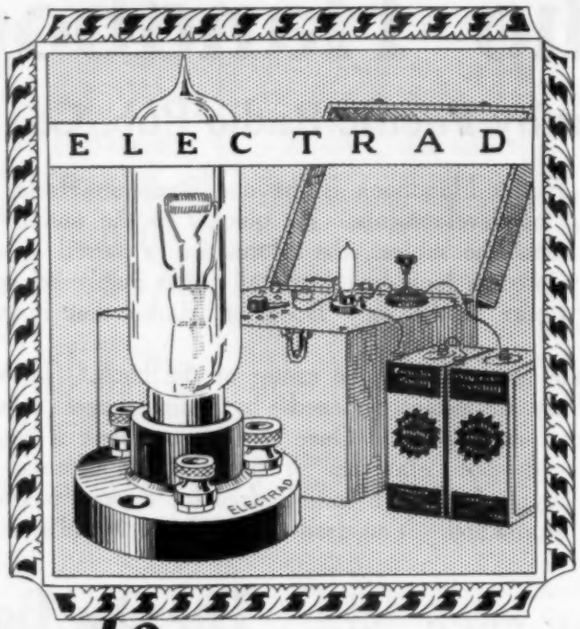

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"A-B-C of Radio"

An illustrated non-technical radio book

25c Per Copy

"RADIO"
Pacific Building
San Francisco

AND IT CAME TO PASS

Continued from page 22

works!" exclaimed the farmer when he getteth near. "They wouldn't believe what I told 'em!" he addeth.

So our long-suffering ham placeth the extra phones upon the knobby head of an equally angular female of uncertain age, and lo, as he doeth so the announcer cometh on and saith:

"The next selection will be "At Four o'Clock in the Morning," at which the angular lady removeth the phone with a sigh saying:

"Just my luck! Wish I could wait for that next selection, but my goodness, we all go to bed at eight-thirty in these parts!"

Whereat our hero stuffeth a handkerchief into his mouth, and his wife wrappeth her head in the tent-flaps, and seemeth perilously close unto an explosion.

And when all was explained, and the only two headsets available were passed out to the crowd, our friend standeth by to answereth questions.

He telleth them that the numbers on the dials are not indicators of the miles away the station is; he assureth them that an ordinary electric light bulb is regarded as inferior to a radiotron; he explaineth that the little coil is the tickler, and then that this coil rouseth not the risibles of sensitive folks, as its name seemeth to imply. He regretteth that he hath never heard to his knowledge the crystal set that a small nephew of a stout lady operateth somewhere in Vermont. He asketh her the call of the station, and she looketh bewildered, and saith that he always called it a radio set, and that was all she knew about it, whereat our hero saith no more along that line.

He explaineth that the holes in front of the bulb are not to let the sound out, and that the set worketh just as well with the cover on, and illustrateth this latter fact. He proveth to a suspicious old spinster that the wires to the car led only to the battery, and not to a concealed phonograph as she seemeth to suspect, and he showeth seven times exactly where the aerial was located, it being so dark that it appeareth not without exact knowledge of its whereabouts. He talketh and explaineth and expoundeth until the Mrs. asketh to be excused, and laith down in the tent with a headache, but the visitors stayeth on and on and on, till the last local station pipeth down for the evening.

And then one of the men peereth at his Ingersoll, and taketh note of the hour, and they all exclaimeth as with one voice that they have not been up so late for they knew not WHEN, and they looketh at our hero as though he was to blame for their predicament. And he looketh at his watch, and, lo, it

Continued on page 72

If you cannot call in person Order by Mail from the largest radio supply house in the West!

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	Our Special
1½ volt Peanut Dry Cells	$ 0.45
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Eveready 22½ volt, tapped	2.50
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Nickel Dials, 3-in. dia.	.50
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Moulded Bakelite, 3-in. Dials	.65

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Manhattan, 2,000 ohm	$ 4.75
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MORE THAN A LOUD SPEAKER THE AUDIOPHONE is a real reproducer of the original broadcasting. It is easy to listen to the Audiophone reproduction, because they are so perfect. The speech, songs and instrumental music are not blurred or disguised by mechanical distortion. You get all the fine shadings and every inflection. In fact, the very personality of the artist seems to be present as you listen.
DEVELOPED in the laboratories of an engineering firm known the world over for recording instruments of precision.
COMPLETE in every way and ready to connect to the receiving set.
NO AUXILIARY BATTERIES are required for magnetizing.
ADAPTED for use on all types of two or three stage power amplifiers.

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PATENT APPLIED FOR

The Missing Link in RADIO

Stops Interference!

The "WAVE TRAP" will eliminate interfering broadcasting stations and enable you to listen to your favorite station.

It will work on any set, greatly increase its selectivity and clearness, and eliminate code and spark stations.

It is mounted on a Formica panel in a handsome mahogany finished cabinet 6x5x6: It is a high grade instrument throughout and a valuable addition to the operation and appearance of any set. It comes to you complete and there are no extras to buy. It is installed in a minute by changing only one outside connection.

Use the "WAVE TRAP" for real results.

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67	Radio Battery Manufacturers	1.50

Ready to send on receipt of remittance
Trade Circular Addressing Co.
166 W. Adams St., Chicago

Tell them that you saw it in RADIO

Continued from page 70

is nine-thirty, even twenty minutes of ten. And to him it seemeth even later!

He sleepeth but poorly, and dreameth all night of fool questions and more foolish suggestions. And he sweareth unto himself that on the next day he and he only, save his wife, useth the set, but lo, he hath no more chance than a man hath of getting connections on a tickler coil right the first time, for scarce hath the dew dried from the grass when the tillers of the soil, and those of their family cometh like locusts and devoureth everything radio that cometh through the ether. The phones passeth from one head to another, and back again, and many quarrels ariseth when individuals developeth porcine characteristics, and trieth to keep the receivers o'er long. And at night it was the same, only more so; and our hero doeth naught but tuneth in carrier waves, and retuneth and readjusteth, and maketh hook-ups and diagrams, and giveth out addresses of dealers—this latter so greatly that he almost weepeth that he selleth not radio goods on commission.

And for three days it goeth this way, and our hero findeth but little time to runneth his trot-line and swimmeth, to sayeth naught of gathering firewood and other camp-like duties, and on the third night his more argumentative half maketh a decision, and accordingly on the fourth day they rise early in the morning and teareth down their aerial, and packeth up all their earthly goods, and lo, they departeth from that place in high, leaving no trace nor address behind.

When they findeth their next camping place our hero stringeth up his aerial in a concealed place, and driveth his ground inside the tent. He bringeth his lead-in to the tent in secrecy, camouflaging it with the vines of the wild grape. He hideth the set under much bedding when not in use, and he letteth no man know of its presence. He stoppeth up the observation-holes in front of the bulb so that no light cometh forth, and operateth in the darkness, with the tent-flaps tied, and lo, he heareth phone and CW and spark to his heart's content, and no man sayeth him nay, or asketh "What cometh in now?" in that let-me-hear-it voice that all radio men knoweth to their sorrow.

And when on the seventh day they packeth up to go home, he proclaimeth that it was a great vacation, and next year, he saith, he will profit himself by his experience, and accordingly ye scribe writeth it here for all and sundry, that others may be warned thereby.

For a radio set in the rural district stirreth up great interest, and he that exposeth one therein is surely not wise!

NEUTRODYNE CIRCUIT

Continued from page 21

11 plates. This, then, reduces the controls to three, the antenna functioning aperiodically, with no more controls than a standard single-tube regenerative receiver would have. Obviously, this will take very well with the lay public, simplicity and ease of control combined with extreme sensitiveness, being the features that the novitiate listener desires.

In the plate circuit of the detector tube (Fig. 1), is shown a variometer to tune the plate to resonance, producing regeneration. If the receiver is to be used for broadcast reception on waves above 360 meters, leave it out, for regeneration in a neutrodyne receiver produces instability, squeals, howls, distortion and general havoc, when in the hands of an unskilled operator.

C_4 and C_5 are the neutralizing capacities which "are in part inherent, existing between the coils and condensers of adjacent stages, and in part added by condensers. These condensers are of very small capacity and are conveniently made in the form of an insulated wire inside a metal tube . . . . . The adjustment of each neutralizing capacity is made experimentally by tuning in some strong signal and then turning out the filament of the tube whose capacity is to be adjusted, but leaving the tube in its socket. If the neutralizing capacity is not correct, the circuits on each side of the tube will have capacity coupling, which will transmit the signal. The neutralizing capacity is then adjusted until the signal disappears . ." Obviously, then, this method of adjustment, shows that the neutrodyne circuit operates to eliminate capacity coupling and is not a method for counteracting the tendency to oscillate. It is distinctly different from methods used heretofore to "stabilize" regeneration, which decrease rather than neutralize it.

In Fig. 2 is shown the neutrodyne circuit with two stages of audio-frequency added. This circuit is non-regenerative and is therefore quite suitable for broadcast reception, with loud speaker attachment.

Within the last six months there has come into prominence a method of making the amplifying tubes do double duty, popularly called "reflex" methods. Consequently, we can expect the neutrodyne circuit to be adapted to this method. In Fig. 3 is shown the neutrodyne-reflex circuit, and is, in the personal opinion of the writer, the ultimate in receiving perfection to date. We are indeed indebted to Prof. Hazeltine for his method of neutralization of capacity coupling.

A Plain Statement of Fact

When you say a circle is round or a man is "square" or a job is done, you've told the **whole story.**

When we say that
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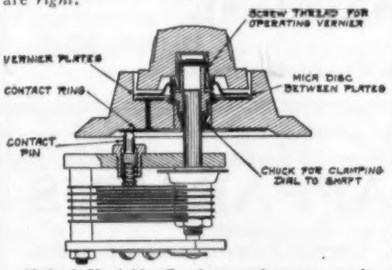
Give Complete Satisfaction
we leave nothing more to be said. They *satisfy* because both design and construction are *right.*



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Vernier alone; attach to any plate Condenser by drilling one hole—$2.50.
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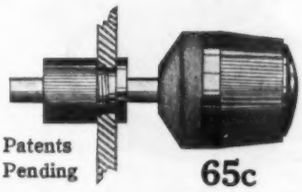

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Easily mounted by drilling only one 5/16" hole. Normal position of Vernier is away from the dial. A slight pressure causes beveled soft rubber of Vernier to make contact with bevel of dial. Vernier is then turned for accurate tuning.

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Variocouplers	5.00	Inductance Switches complete with 7 points and 2 stops	.50
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Rheostats	.75	Binding Posts, N. P. or Insulated Knob	.08
Mahogany cabinets, various sizes	$5.00 up		
Bakelite sheets	per lb., $2.00		
Straight Circuit Tuner with Detector	$35.00		
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For Wireless reception. Patent applied for.

Alpha Type I, 5 volt, .25 Ampere.

Alpha Type II, 1½ volts, .25 Ampere. Dry cell.

New *Alpha* Type III, 2½ volts, .08 Amp. Dry cell.

Plate voltage 20 to 90 volts.

The quality of these tubes is of the highest and they are fully guaranteed.

Price $5.00. *At your Dealer or Direct*

Prepaid to any part of the U. S. A.

Manufactured by

F. ALEXANDER

62 West 14th St., New York City

HYGRADE SPECIALS

200 ft. 7 strand No. 22 Copper aerial wire	$1.40
Morse Eureka Test Clips, per dozen	.50
Nathaniel Baldwin Head Sets (Type C)	9.50
No. 763 Eveready 22½ V. Variable B. Bat.	1.25
No. 766 Eveready 22½ V. Variable B. Bat.	2.25
No. 767 Eveready 45 V. Variable B. Battery	4.25
2000 Ohm Murdock No. 56 Head Sets	4.49
3000 Ohm Murdock No. 56 Head Sets	4.98
Federal or Brandes 2200 Ohm Head Sets	6.50
Dictograph 3000 Ohm Head Sets	6.98
Fada or Framingham Rheostats	.65
Acme Amplifying Transformers (new type)	4.25
Acme R. F. Transformers, Types R2—R3—R4	4.25
6 Volt Marko Storage Batteries	8.95

All orders must include Parcel Post charges

Hygrade Electrical Novelty Co.,

41 West 125th Street New York, N. Y.

RADIO ON S. F. "MAJESTIC"

Continued from page 34

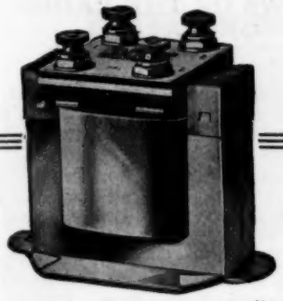
shore stations of the Radio Corporation of America at speeds of over 80 words per minute when the vessel was 1000 miles at sea. Ordinarily speeds in excess of about 25 words per minute cannot be attained by hand sending and, in order to meet the demands of increasing radiogram traffic created by the large passengers liners, machine sending must be used in which case a given message can be sent and received in one-third the time required by manual methods.

The earlier experiments aboard the *Majestic* permitted only one-way high speed transmission, namely, from ship to shore, there being no apparatus on board the vessel capable of receiving high speed transmission. In order to effect *two-way* high speed telegraphic service on the vessel during its last voyage to New York, it was equipped by the Marconi Company with a high speed receiver which worked most satisfactorily. High speed signals were also received from "Paris" at a distance of 800 miles at a speed of 80 words per minute. Wireless press was completely and perfectly recorded by the automatic receiver through medium static from the station of the R. C. A. at Chatham, Mass. At the same time that this automatic high speed reception was carried out it was possible for the operator on watch to listen in on the ordinary ship's wavelength for general "ship-to-ship" wireless.

Not only does the use of automatic high speed receiving and sending apparatus enable operators to handle more traffic in less time and thereby provide freedom of the ether for other vessels to operate their radio sets but in addition secrecy of communication is maintained, owing to the great rapidity with which the dots and dashes are transmitted. It is difficult for the average operator to copy over 30 words per minute for any length of time, consequently when working at double speed the telegraph characters follow in such rapid succession that they cannot be deciphered.

While the tests so far made by the Marconi International Marine Communication Co. and the Radio Corporation of America have proved highly successful, the principal benefits will be derived from this new apparatus when installed on all vessels of the larger type and which handle great volumes of traffic.

M. C. Rypinski, vice-president and general sales manager of C. Brandes, Inc., New York City, is making an extended survey of radio conditions in Europe. The Brandes Co. is said to be the largest consumer of No. 40 wire in the world, this being used in the manufacture of their matched tone headsets. Their monthly consumption of this wire is sufficient to reach 1½ times around the earth. Yearly, they use nearly half a million miles of this hair-like wire.



Couple up these two for Highest Amplification

On the First Step

Thordarson
6 to 1 Ratio
A. F. Transformer

The ideal two step amplifier has a Thordarson 6 to 1 ratio transformer on the first step.

This is a new product — recently perfected and is distinguished from our 3½ to 1 ratio transformer by the red lettering on the top plate. It gives unusually high amplification without distortion, the core having twice the cross-section of the ordinary transformer.

Remarkably low priced to retail at $5.00. Good discounts.

We should be able to make better radio transformers for less. And we do!
We have specialized in transformers for the last twenty-five years. That means we know how to make them right! We have the men and the manufacturing facilities to produce them in quantity. That means we can make them economically!
Together they mean the best audio frequency amplifying transformer that can be made, at the lowest possible cost.
Hook up to Thordarson Transformers and see what perfect amplification really means. If you are a dealer, demonstrate to your customers what a perfect combination two Thordarson Transformers make for a two step amplifier—
These transformers can be used with excellent results on low voltage tubes.
And such a demonstration will certainly make sales if results are what your customers are after.

Get a supply of Thordarson Transformers from your jobber now

THORDARSON
ELECTRIC MANUFACTURING CO.
500 W. Huron St., Chicago, Ill.

On the Second Step

Thordarson
3½ to 1 Ratio
A. F. Transformer

For best results and perfect reproduction of signals, the 3½ to 1 ratio transformer should be used on the second step. Used together in this way, these two transformers give exceptionally loud signals, yet in perfect modulation.

The Thordarson 3½ to 1 ratio transformer is distinguished by the black lettered top plate.

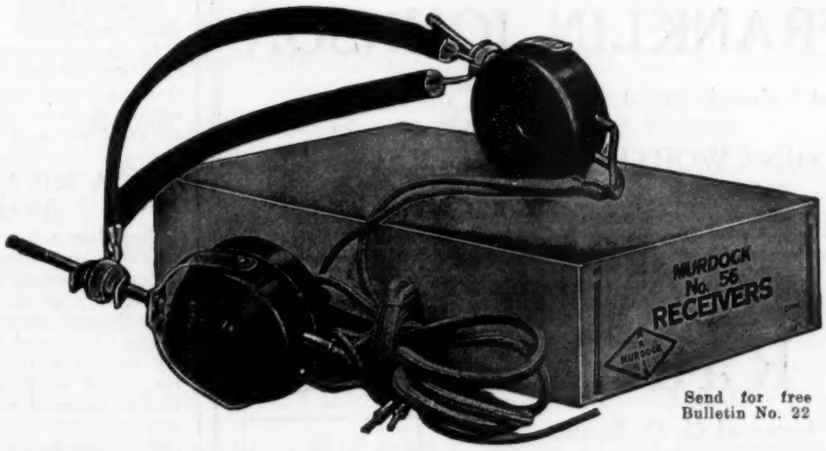
All silk insulated wire used throughout. Unequaled value at $4.50 list—also with good discounts.

You can get MURDOCK Receivers

AND OTHER MURDOCK RADIO APPARATUS

---Why bother with any other kind?

$5.00
2000 Ohms
No. 56
Double



$5.50
3000 Ohms
No. 56
Double

Send for free Bulletin No. 22

If your dealer is not supplied send remittance direct to us and your order will be promptly filled.

MURDOCK MADE 800,000 TELEPHONE RECEIVERS BEFORE GOING INTO THE RADIO BUSINESS AND HAS MADE THE BEST RADIO RECEIVERS FOR 14 YEARS

We carry a complete stock in our Pacific Coast warehouses. Write for dealer discounts.

KEELER WHITE COMPANY
Pacific Coast Agents—WM. J. MURDOCK CO.—Since 1905
509 Mission Street, SAN FRANCISCO

PRE-INVENTORY RADIO SALE

	Regular Price	Sale Price
Federal detector and one-step	$ 52.00	$ 30.00
Federal two-step amplifiers	58.00	35.00
Clapp Eastham wave meter	27.00	15.00
Clapp Eastham detector and one-step	35.00	20.00
Turney spider web inductances	5.85	3.00
Radio instrument DX receivers		40% Off
General Electric crystal receivers with headset	18.00	12.00
Crystal receiver with headset and buzzer practice set with battery	17.00	10.00
John Firth detector control cabinet	10.50	8.00
Acmefone receivers with detector and two-step amplifier and loud speaker	80.00	50.00
King Amplitones	12.00	8.00
Paragon Transmitters (C. W. Voice and I. C. W.)	72.00	50.00
Meyers tubes with sockets	5.90	4.50
Paragon tuner, detector and two-step	140.00	110.00
Hall relay—automatic code receiver	160.00	40.00
Dials—		
4-inch Tuska, ¼ and 3-16	1.65	.60
4-inch Paragon, ¼	1.75	.60
3-inch Paragon, ¼	1.00	.60
2-¼inch Paragon, ¼	.90	.60
2¾-inch Composition	1.00	.60
General Apparatus, ¼	1.25	.60
Bausch & Lomb Precision Binoculars, six-power	50.00	40.00

PAUL FRANKLIN JOHNSON

560 East Colorado Street, Pasadena, California

"EVERYTHING WORTH WHILE IN RADIO"

7 VOLUMES

"Easy Radio Course"

Edited by General G. O. Squier

A wonderfully complete and instructive course in Radio. Illustrated with many photographs and diagrams. Supply limited.

ONLY **$3.50** POSTPAID

PACIFIC RADIO PUBLISHING CO.
Pacific Building San Francisco

Tell them that you saw it in RADIO

NEWS OF THE RADIO OPERATORS

Continued from page 40

James Brown, 6BKI, advises that his address is 725 E. Hill St., Long Beach, Calif., and not Los Angeles, Calif., as stated in the call books.

E. S. McGaughney, 200 E. Ave. 56, Highland Park, Los Angeles, Calif., advises that call letters 6AQD have been re-issued to him.

E. W. Thatcher, formerly 6AWP at Santa Ana, Calif., is now 8YAE at Oberlin, Ohio, where he is attending college. He has installed the 10 watt transmitter which reached out so well from Santa Ana and worked 6XAD the first night and has received many other reports from the Pacific Coast.

REPORTS OF 6XAD-6ZW, AVALON, CATALINA ISLAND, CALIFORNIA

On May 7th, MacLurcan of Sydney, Australia, cabled that 6XAD was clearly heard in test. Was using 100-*watt set.*

R. F. Shea, 19 Laurel Str., Arlington, Mass., reports 6XAD—qsa. Allen W. Jones, Boston, Mass., reports "qsa."

2le, 3arp (3asy), 3bvh, 3bqf, (3bva), B. Aitchison, Washington, D. C., 3apz, 3sxc (Can.).

H. E. Gifford, Florence, So. Carolina, reports 6XAD, 6ZW, qsa, 4fv (Can), 4kl, 5jf, (7adp), (7adg).

8ij, (8adg), 8cjd, 8anv, (8brl), 8cpy, (8ckv), (8cpx), Walter C. Olson, Jamestown, N. Y., reports 6xad, 6zw, qsa, 8aco, (8pd), 8boy, 8bdv, (8yae), (8caa), (8jj), (8aph), 9aix, 9cui, (9azg), (9cba), (9cnv), 9dbn, (9bun), 9dmw, 9bvy, 9brk.

(My DX list is small this month, as 6XAD-6ZW is practically shut down for the summer.)

LETTERS TO THE EDITOR

Continued from page 38

It might be well to fuse the battery circuit to prevent discharge of the battery in case of accident. Such short circuit currents are usually quite high.

Contacts should be cleaned occasionally to insure good results.

If the core becomes to hot, it is an indication that the iron is of inferior quality and is being pushed too hard magnetically. The solution is to use more iron, that is, increase the cross section of the core. —F. Fox.

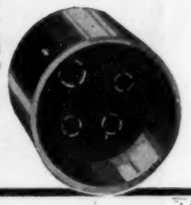
"A Soft Answer Turneth Away Wrath"

Sir: Just a line to let you know how we amateurs and members of the ARRL are trying to overcome the wrath of the B. C. L. in the city of Kalamazoo, Michigan. We have formed what we call the "Kalamazoo Relay Club" and are banded together for the purpose of relaying FREE messages for the people of Kalamazoo. We have had several thousand message blanks printed up and left them in the leading stores of the city for the people to use at their convenience. We have had several write-ups in the local newspaper telling about this service and explaining where blanks may be filled out, how the messages will be handled, and pictures of various stations. We have also a "radio central" station in the Central High School, where an operator is on duty to receive messages by telephone or in person.

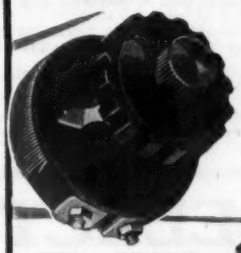
Each day one of the members collects the messages from the stores and distributes them

Continued on page 78

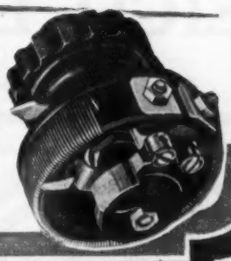
KING QUALITY "Universal" Adapter. R-10 designed to fit all tubes and valves.



KING QUALITY Rheostat. R-630 Resistance valve 6.5 ohms. Special Brass Panel Bushing insures smooth operation. Genuine Bakelite Base and Knob.



KING QUALITY Vernier Rheostat. R-631 provides micrometer adjustment resistance. Superior construction assures perfect control.



KING QUALITY
ALL THE NAME IMPLIES
RADIO APPARATUS

QUALITY—so outstanding in appearance, in design, in workmanship, in serviceability—that none dare deny its superiority.

Such a line as KING QUALITY any dealer may be proud to display and offer his customers as the Best on the market.

Increased sales and profits are the result of tying up with the KING QUALITY line. Write today to

RADIO APPARATUS DIVISION
King Sewing Machine Co., Buffalo, N. Y.
We maintain our own Bakelite Plant

RARE OPPORTUNITY—SUPERIOR SERVICE

MAIL ORDER SERVICE ONLY

Why not save money when you have the opportunity? Our buying power enables us to offer you this opportunity. Send us your order and be convinced.

Below are some of our Money-Saving Prices:

Audio Transformer	**$3.75**	Bakelite Rheostat with Vernier	**$1.40**	Inductance Switch	**30¢**
R. F. Transformer	**$2.50**	Filament Rheostat	**80¢**	Sockets, Small	**30¢**
Bakelite Variometer, 180 degrees	**$5.50**	All Wave Coupler, *Special*	**$5.00**	Jacks, Single, Open	**60¢**
Bakelite Variocoupler, 90 degrees	**$5.50**	Condenser, 3 Plate, Plain	**$1.50**	Jacks, Single, Closed	**70¢**
Mahogany Variometer	**$4.00**	Condenser, 11 Plate, Plain	**$2.25**	Grid Leak and Condenser, 0.0005 or 0.00025	**20¢**
Mahogany Variocoupler	**$3.75**	Condenser, 11 Plate, Vernier	**$4.00**	Phonograph Attachment	**$1.00**
Midget Vernier Condensers, *Special*	**$1.00**	Dials, 2 and 3 inch	**30¢**	Peanut Tube Socket	**80¢**
		Dials, 4 inch	**75¢**	Peanut Tube Adaptors	**80¢**

We pay postage on all shipments. Will send C. O. D. if 1/3 of purchase price accompanies order. Do you want our money-saving monthly bulletin? It is yours for the asking.

ROSS RADIO SERVICE

693 Mission Street **San Francisco, Cal.**

Use a *Leich Non-Tune Rectifier* For Charging *Your Radio Storage Battery*

The Leich NON-TUNE Rectifier has a charging rate of 2 amperes when connected to a six volt storage battery.

This rate is sufficient for home use where three to four 5 watt tubes are operated.

Before many months one to one and one-half watt tubes (1¼ amp.) will be common practice.

Here the Leich NON-TUNE Rectifier is in a class by itself, highly efficient; at full load it consumes less current than a 40-watt lamp; reliable, and with a charging rate to assure long life to the battery.

NON-TUNE FEATURE, gives this charger flexibility in its operation, allowing for considerable voltage and frequency variation of the power circuit.

A PATENTED RELAY LOCK keeps the battery circuit open when the power current fails.

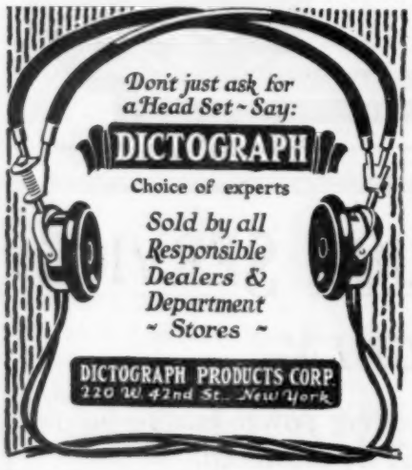
LEADING RAILROAD COMPANIES have used Non-Tune Rectifiers for years for charging batteries in their signal service because Non-Tune can be depended upon to function properly at all times.

Try a NON-TUNE. Ask your dealer or write for Bulletin No. 101B.

LEICH ELECTRIC CO.

Manufacturers **Genoa, Illinois**

NON-TUNE RECTIFIERS—LEICH COMFORTABLE HEADPHONES



LEARN RADIO

Here's your opportunity. Radio needs you. Win success in this fascinating field. Trained men in demand at highest salaries. Learn at home, in your spare time.

Be a Radio Expert

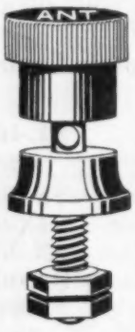
I will train you, quickly and easily, to design, construct, install, operate, repair, maintain, and sell all forms of Radio apparatus. My new methods are the most successful in existence. Learn to earn

$1,800 to $10,000 a Year

FREE Wonderful, home-construction, tube receiving set, of latest design. Write for "Radio Facts" free. Engineer Mohaupt.

American Electrical Association
Dept. 294 4513 Ravenswood Ave., Chicago

"Read'em" *Binding Posts*



With knobs that won't come off.

Anyone can "read 'em." Irremovable knobs. All popular styles—Antenna, Ground, Fones, A and B Battery plus and minus — abbreviations of different names engraved on knobs. Radio users—ask your dealer for "Read 'em." Dealers—write for our proposition on this big seller. Write Dept. B for liberal profit proposition.

The Marshall-Gerken Co.
Manufacturers
DO OHIO

ABOLISH STORAGE BATTERIES

The BRU No. 5 receptacle in your circuit will accomplish this.

NO TROUBLE CHARGING

NO TROUBLE HANDLING

Replace dirty storage battery with neat 1½ volt dry cell. Use BRU No. 5.

Fit your circuit with BRU No. 5 Moulded Bakelite Socket.....75c each

BRU No. 5 Pat. Pend.

Bruno Radio Corp., New York
152 West 14th St.

"Add-A-Vernier"

fits any

Variable Plate Condenser

Price 75 Cents

Jobbers and Dealers Write for Discounts.

JOHNSON ELECTRIC CO., Mfrs.
1113 N. Broadway Oklahoma City

Continued from page 76

to the various stations best equipped to handle each particular message. Most of the messages are handled by radio fone for distribution from the "Radio Central" and in this way the sender of the message is usually impatiently waiting to hear his or her message over the radio fone. We handle a great number of messages for the people this way and are very glad to note that many answers are coming back from those receiving the messages. We are just beginning to reap what we planned to do in the start. The appreciation of the general public and the B. C. L. especially is great. They wish to hear their messages being sent out and they want us to do it *early in the evening so they can hear them.* Now we don't claim any great honor for the idea or even claim it as original, but do claim that we are *succeeding* in bringing the B. C. L. and general public to respect our place in the ether.

Many of the B. C. L.s now wish to learn the code and want to become dyed-in-the-wool amateurs, and we are helping them and doing all possible, and then some, to bring about this kind of a feeling. We know this is no cure-all for all localities, but sure works here in this city of 65,000. We have a live bunch and are doing things and want to hear from any other live bunches in the country that are *"Doing"* things to harmoniously straighten out the difficulties. We are open to constructive criticism and welcome it from anyone who has had experience along these lines. Wish to say that the "proverbial message" "tux fr crd" has no place on our hooks. We have plenty of msgs without the useless ones. We ask that you co-operate with us in handling these messages and *be sure* to deliver them and *Get An Answer.* Address any letters to Jas. A. Wilson, 8CPY and 8DKC, care Crescent Engraving Co., Kalamazoo, Mich.

CALLS HEARD

Continued from page 48

By 6BUH, Salt Lake City

1bht, bt3, can4bv, can4cl, 4fv, 4xjv?, 5aah, 5ado, 5aec, 5anx, 5be, can5cn, 5cy, 5di, 5gg, can5go, 5ke, 5lh, 5px, 5ui, 5yq, 5za, 5zak, 5zat, 5zav, 5zh, can5zo, 6aat, 6abs, 6abv,spk, 6abx, (6atq), 6acm, 6agj, 6ahp, 6ahv, 6ahu, 6ajf, 6alu, 6alv, 6amn, 6ape, 6atj, 6atu, 6avr, 6avv, 6awt, 6awx, 6alx, 6bbc, 6bcl, 6beg, 6bet, 6bfl, 6bhp, 6bip, 6biq, 6bod, 6bok, 6bon, 6boo, 6bpl, 6bqb, 6bqd, 6brf, 6bu, (6bri), 6bua, 6bug, 6bun, 6buo, 6buy, 6bvf, (6bvg), 6bwl, 6bwp, 6bum, 6bou, 6bzd, 6cay, 6cbi, 6cc, 6cee, 6cey, 6cfq, 6cga, 6cgd, 6cgg, 6cgu, 6cjb, 6cje, 6cqt, 6cu, 6cuo, 6dr, 6eb, 6ec, 6eo, 6gh, 6gx, 6hv, 6ju, 6ka, 6lv, 6lu, 6ny, 6iv, 6tu, 6tw, 6vm, 6yc, 6zao, 6zh, 6zi, 6zz, 7adp, 7aea, 7afw, 7afo, 7aiy, 7ak, 7anf, 7bb, 7bej, 7bj, 7brs, 7dc, 7dh, 7em, (7hs), 7io, 7jw, 7ks, 7lr, 7lu, 7mk, 7na, 7nr, 7pf, 7qt, 7sc, 7sf, 7tj, 7tq, 7vf, 7we, 7wm, 7wx, (7zf), 7zh, 7zl, 7zn, 7zu, 8bis, 8eq, 8?nx, 9abc, 9abu, 9aey, 9aiy, 9amb, 9anq, 9apf, 9apw, 9ary, 9avu, 9avz, 9ayu, 9azg, 9bie, 9bjc, 8bji, (9bjk), 9bli, 9bri, 9bsg, 9bto, 9bun, 9bvl, 9bx, 9bxa, 9bxm, 9bxq, 9caa, 9ccs, (9ccz), 9ceh, 9cjc, 9cjj, 9cjy, 9cmk, 9czw, 9dbl, 9dge, 9djn, 9dri, 9dte, 9dvj, (9dwn), 9eca, 9ecv, 9ehj, 9kh, 9kx, 9uh, 9xaq, 9zt.

Spark—6abv, 6alk, 6alu, (6apl), 6aqu, (6atu), 6amk, (6bak), 6bbe, 6bke, (6bqt), 6fc, (6gt), (6od), 6wj, 7abh, 7acm, 7kj, 7nr, 7pf, 7tw, 9auu.

Pse qsl when u log 6buh.

By 9ZT, D. C. Wallace, 54 Penn Ave. N., Minneapolis, Minn.

1aw, (1wc), (1boq), 1ckp, 1cmp, 1cna, 2wr, 2agb, 2awl, 2bzv, 2cwo, 3ab, 3bq, 3cx, 3gc, 3jj, 3jl, 3zo, 3bfu, 3bhl, 3bnu, 4cg, (4eb), 4pu, (5cy), (5di), (5ek), (5ll), (5nk), (5nn), (5nv), (5px), (5xa), (5xy), (5za), (5abh), 6by, 6ea, 6ec, 6jd, 6mo, 6yu, 6zh, 6zw, (6zz), (6aak), (6acm), 6ado, 6alk, 6aqp, 6azv, 6bnt, (6bqc), 6bqd, (6brf), 6bun, (6bvg), (6caj), 6xad, 7iw, (7so), 7sf, (7tg), (7zf), 7zo, (7zu), (7acm), 7adp, 7ahc, (7ahi), (7aiy), (8fl), (8gp), (8qk), (8rv), (8ada), (8apw), (8azo), (8cbi), (8cbg), (8cjh), (8cmi), (8cpd), (8cur).

Canadian—(2bn), 3co, 3da, 3ko, 3nb, 3ni, (3si), 3ta, 3xm, 4cn, 4fn, 4hh, 9bx, 9cd, (9dy). Please note address—am not in call book.

Continued on page 80

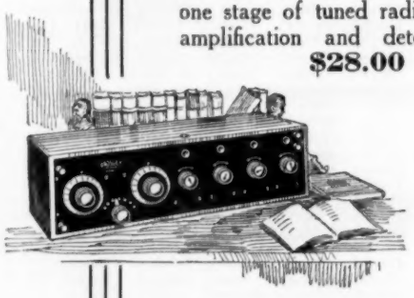
Just one Reason why CROSLEY RADIO RECEIVERS are *so much better*

The heart of any receiver is the variable condenser. The superiority of the Crosley hook-type variable condenser over the old type interlocking plate air condenser is now generally admitted for the following reasons:

1. Rugged construction that prevents damage.
2. Freedom from short circuits.
3. Permanent metallic contact with plates eliminates sliding contacts.
4. Minimum stray electrostatic field eliminates body effects when tuning.
5. Liberal leakage paths through condenser.
6. Grounded frame provides electrostatic shield.
7. Minimum high frequency resistance or energy loss.
8. Maximum variation in wave length with fixed coil.
9. Maximum mechanical and electrical efficiency.
10. Minimum cost.

We state positively that the substitution of a Crosley condenser for any other type of commercial receiving condenser in any receiving set or circuit will greatly increase the range, volume and simplicity of tuning.

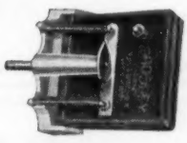
The justly famous Crosley Model VI, a two tube set incorporating one stage of tuned radio frequency amplification and detector, price **$28.00**



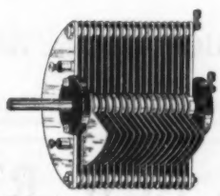
The standard Model X that has made history during the past year and is now recognized as the mos efficient set on the market, will bc continued at the same price, **$55.00,** notwithstanding the advanced cost of materials.

We announce a new Model X, to be designated as Model X-J, equipped with head phone jacks for detector and one stage of amplification, in addition to loud speaker binding posts.

The instrument has been redesigned internally with new molded sockets, condensers having molded plates, rheostats in molded shells, new dials; price—**$65.00.**



New Crosley type D Condenser has molded plates. Price **$2.25.**



Old-fashioned multiple plate condenser which has been largely replaced by Crosley type D.

New York Office, C. B. Cooper, 1803 Tribune Bldg., 154 Nassau St.

Boston Office, B. H. Smith, 929 Blue Hill Ave., Dorchester.
Chicago office, 1311 Steger Bldg., 28 E. Jackson Blvd. R. A. Stemm, Mgr.

Crosley receivers incorporating tuned radio frequency amplification reduce static and other interference to a wonderful degree, which greatly increases summer receiving range.

CROSLEY MANUFACTURING CO.

519 ALFRED STREET ***CINCINNATI, OHIO***

PARTS

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RADIO RESEARCH GUILD
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Continued from page 78

By 5KC, Plaquemine, La.

Spark: (5ag), (5aq), (5ea), (5oi), (5aay), (5adi), (5air), (9aaw), (9amk), (5zab), (9aaw), (9amk), (9apn), (9aqe), (9auc).

C. W.: Cy1, (1fb), (1fd), (1rd), 1adl, (1ajp), (1aok), (1ban), 1bgf, (1bop), (1ccz), (1xm), 1xu, (2by), 2el, (2fp), 2ho, 2om, 2pu, (2agb), 2aho, 2ajw, 2amb, 2ayv, 2bfx, 2bof, 2bod, 2bzo, (2ccd), 2cfi, (2cpd), 2cqz, 2xi, 2zl, 2zo, 2xap, (3ab), 3ba, 3bv, (3bz), (3ca), (3cc), 3cm, 3dh, (3fq), (3fs), (3hd), 3hl, (3hs), 3jj, 3ok, 3nb, 3ot, (3pz), (3rf), (3su), 3tj, (3aao), 3aay, 3abf, 3afb, 3aln, (3apr), 3bfu, 3bhl, (3bhm), (3bij), (3bkc), (3blf), (3bof), 3bss, 3buv, (3bva), 3bvl, (3cxz), 3zw, (3zz), (4ag), (4ai), (4ar), (4as), (4bf), (4bi), (4bk), (4bq), (4by), (4cg), (4cl), (4co), (4cy), (4dc), (4dg), (4dl), (4dq), (4eh), (4el), (4eq), (4fe), (4fj), (4fs), (4ge), (4gh), (4hw), (4iz), (4jk), (4jy), (4jz), (4kc), (4kf), (4kl), (4ku), (4le), (4me), (4nt), 4oi, (4pd), (4xj), (4ya), (4xk), (5ae), (5ba), (5be), (5bm), (5bp), (5bq), (5bw), (5ci), (5co), (5cy), (5da), (5de), (5di), (5dn), (5do), (5dq), (5dw), (5dy), (5ek) (5en), (5es), (5fa), (5fv), (5ga), (5gg), (5gi), (5gp), (5gr), (5hb), (5hg), (5hh), (5hl), (5ho), (5hu), (5ik), (5im), (5iq), (5is), (5ix), (5jb), (5jl), (5jm), (5jt), (5jw), (5kg), (5ki), (5kk), (5kn), (5kp), (5kr), (5ks), (5lb), (5lj), (5mb), (5mo), (5nk), (5nl), (5nn), (5nv), (5nz), (5ov), (5pb), (5pf), (5pn), (5po), (5pv), (5px), (5qi), (5qy), (5rh), (5rj), (5rn), (5sf), (5sk), (5sm), (5sr), (5ss), (5sz), (5ta), (5tc), (5tj), (5tm), (5tp), (5uj), (5uk), (5uo), (5us), (5vm), (5vr), (5vv), (5vy), (5wz), (5aaf), (5aag), (5aar), (5aat), (5aba), (5aby), (5acq), (5adb), (5ade), (5aec), (5afq), (5agj), (5ahh), (5aib), (5air), (5ajc), (5xa), (5xv), (5xy), (5yg), (5za), (5zb), (5zh), (5zs), (5xad), (5xaj), (5zae), (5zag), (5zan), (5zas), (5zaz), 6cu, (6ea), 6eb, 6gr, (6if), (6jd), (6ka), 6ti, 6vm, 6aag, 6abx, (6amn), (6apw), 6arb, 6avd, 6avv, (6awt), 6awx, 6bem, 6beq, 6bic, (6bod), 6boy, 6bqc, 6brf, 6bum, 6bvf, (6bvg), 6caj, 6xk, 6zf, (6zh), 6zo, 6zr, 6zz, (6xad), 6zac, 7ba, 7bj, 7jf, 7lu, 7pf, 7sc, 7uz, 7anf, (ad7), 7zo, 7zu, 7zv, (8aa), (8ab), (8ci), (8cp), (8cy), (8ft), (8gz), (8hn), (8ii), (8jj), (8ju), (8kr), (8oi), (8ow), (8sb), (8sp), (8vy), (8wv), (8wx), (8aaf), (8abb), (8abs), (8abz), (8adg), (8afy), (8aig), (8aih), (8aim), (8aio), (8aje), (8ajx), (8alc), (8alo), (8alt), (8ame), (8anb), (8anv), (8apw), (8aqo), (8aqv), (8asb), (8awt), (8axb), (8axt), (8azd), (8azq), (8bch), (8bdb), (8bdv), (8ben), (8bfm), (8bgq), 8bho), (8bke), (8bfm), (8bmf), (8bmg), (8bnh), (8bog), (8bpu), (8bqa), (8brm), (8bvr), (8bwa), (8bxh), (8bxt), (8bxx), (8byh), (8caz), (8cei), (8cgj), (8cgx), (8chb), (8cie), (8cih), (8cjy), (8cko), (8ckv), (8cpx), (8cqh), (8cur), (8cwx), (8cyt), (8cyu), (8czn), (8czz), (8 dak), (8dal), (8yv), (8yae), (9ar), (9bp), (9cp), (9cr), (9dk), (9dr), (9ei), (9ep), (9ew), (9fk), (9fm), (9gk), (9ii), (9io), (9km), (9kp), (9lh), (9lq), (9lz), (9mc), (9nu), (9ox), (9qb), (9rc), (9rr), (9st), (9uc), (9uh), (9uk), (9us), (9uu), (9vk), (9vm), (9aap), (9aav), (9abu), (9abv), (9adx), (9aec), (9afk), (9ahr), (9ain), (9ajh), (9akd), (9aku), (9als), (9amb), (9amh), (9aog), (9aon), (9aou), (9apa), (9apn), (9aps), (9apw), (9aqa), (9arg), (9arj), (9arz), (9atn), (9avc), (9avm), (9avn), (9avz), (9awc), (9awf), (9axu), (9ays), (9ayu), (9bcb), (9bcr), (9bdb), (9bdr), (9bds), (9bdz), (9bed), (9bem), (9bey), (9bfg), (9bgh), (9bgl), (9bhd), (9bhi), (9bhm), (9bij), (9bjk), (9bjn), (9bkc), (9bkj), (9bko), (9bkp), (9blg), (9blo), (9bly), (9bqw), (9bsg), (9bsz), (9bta), (9buh), (9bvp), (9bvy), (9bxd), (9bxm), (9bze), (9bzi), (9bzn), (9bzo), (9ccs), (9ccv), (9ccx), (9cdb), (9cdk), (9ceh), (9cfi), (9cfk), (9cga), (9cgk), (9cgx), (9cho), (9cie), (9cin), (9ciy), (9cja), (9cjj), (9cjm), (9ckp), (9cks), (9clq), (9cmd), (9cmk), (9cmn), (9cmv), (9cnv), (9cpa), (9cpi), (9cpq), (9cpv), (9ctg), (9ctv), (9cuc), (9cui), (9cov), (9cwa), (9cwc), (9cxc), (9cyi), (9czs), (9dah), (9dax), (9dbv), (9dcb), (9dcf), (9dcr), (9dct), (9dcw), (9dex), (9dfb), (9dge), (9dgi), (9dhb), (9dib), (9dio), (9djb), (9djf), (9djm), (9djn), (9djq), (9djx), (9dkk), (9dkx), (9dky), (9dle), (9dlr), (9dnh), (9dpd), (9dpf), (9dpl), (9dpv), (9dpx), (9dpy), (9dqa), (9dqq), (9drw), (9dsl), (9dsm), (9dsv), (9dta), (9dts), (9dug), (9dwe), (9dwf), (9dwk), (9dwm), (9dwn), (9dxc), (9dxk), (9dxn), (9dyn), (9dzq), (9dzy), (9ecb), (9eea), (9efc), (9egy), (9ehj), (9eis), (9ekf), (9eky), (9els), (9xl), (9yb), (9yu), (9zl), (9zn), (9xac), (9xai), (9zaa), (9zaf).

Canadian—(3gb), 3jl, (3oh), 3ss, 3sx, (3uj), 3xn, (3adn), 9bu.

Mexico—(jh), bx, (ax), db.

By Radio 6ZT, P. O. Box 772, Salt Lake City

Can. 4hh, 5ado, 5aec, 5aib, 5ck, 5gg, 5gj, 5mc, 5sr, 5tc, 5xaj, 5za, 5zak, 5zat, 5zav, 5zax, 5zg, 5zh, 7adg, 7ads, 7afw, 7ahw, 7aiy, 7dh, 7dp, 7eq, 7hj, 7io, 7jg, 7lu, 7mc, 7na, 7om, 7pf, 7ri, 7sc, 7tq, 7wm, 7zf, 7zl, 7zo, 7zv, 8ib, 9aap, 9aau, 9abu, 9aec, 9ahh, 9ami, 9apf, 9aps, 9apw, 9asf, 9aua, 9auw, 9avu, 9avz, 9bji, 9bjk, 9bkj, 9bkw, 9btt, 9btx, 9bun, 9bzi, 9caa, 9cdr, 9ccv, 9ceh, 9cfy, 9cit, 9cuc, 9cvg, 9cvo, 9cwc, 9cwr, 9dhi, 9dhs, 9dky, 9dpx, 9dsm, 9dsw, 9dte, 9dts, 9dug, 9dvj, 9dwn, 9eea, 9egy, 9eil, 9ekh, 9gk, 9nr, 9ql, 9rc, 9uh, 9uu, 9ve, 9yb, 9yr, 9yw, 9xi, 9xaq.

Continued on page 82

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"WHERE RAIL AND WATER MEET"

Page 65
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Continued from page 80

By "BX" EX 6XXA, Harold T. Mapes, Guanajuato, Gto., Mexico

1azw, 1ckp, 1ajp, 2ud, 2fp, 2axo, 3yo, 3vo, 3dh, 4ab, 4bi, 4eh, 4fg, 4fs, 4cg, 4hw, 4km, 4yd, (5ado), 5ae, 5aec, 5ade, (5acf), 5aas, 5aar, 5afo, 5adb, 5aib, 5ahd, 5aiv, 5aht, 5aby, 5abe, 5ahh, 5ajc, 5aki, 5aiu, 5aeh, 5afq, 5adr, 5ahr, (5aat), 5agj, (5abh), (5be), 5bm, 5ck, 5ci, 5co, 5cy, 5di, 5da, 5dq, 5en, 5ek, (5ft), 5fv, 5fa, 5fc, 5fo, 5gj, 5gam, (5gr), 5gen, 5gn, 5gt, 5ga, 5gg, (5hz), 5hh, 5ho, 5ix, 5ir, 5ia, 5iq, 5jb, 5jai, (5jl), 5jm, (5jt), 5jz, 5js, (5jf), 5kc, (5kp), 5ke, 5kg, 5kw, (5kn), 5la, (5mt), 5me, 5mx, 5mo, 5mx, (5nn), (5nk), 5ns, 5no, 5nz, 5ox, (5ov), 5oi, 5ok, 5of, (5po), 5pv, 5px, 5pn, 5pk, 5pf, 5pd, 5pz, (5qi), 5qy, 5qa, (5rh), (5rn), 5re, 5rr, (5sf), (5ss), 5sm, 5sz, 5sk, 5tk, (5tj), 5tc, 5ta, (5tm), 5uj, 5uo, 5uk, 5ug, 5un, 5vm, (5vy), (5va), (5vo), 5wz, 5xvh, 5xa, (5xaj), 5xd, 5xx, 5xy, (5xad), (5xv), (5xb), 5xab, 5zav, 5zaa, (5zak), 5zat, 5zb, 5zu, (5za), 5zo, 5zag, 5zas, 5zae, 5zs, 5zg, 5zax, 5zap, 5zh, 5zb, 6ak, 6anh, 6agp, 6abx, 6avd, 6amz, 6ajf, 6arb, 6apw, 6aeq, 6aw, 6ah, 6akl, 6alu, 6awx, 6aoi, 6awt, 6ao, 6ahq, 6acm, 6aqp, 6avn, 6ahu, 6avr, 6alk, 6bko, 6boe, 6bun, 6brf, 6bjq, 6bvw, 6brs, 6bum, 6bvq, 6bod, 6bpz, 6biq, 6bqc, 6bv, 6beq, (6bsq), 6bic, 6bjr, 6bjy, 6bjj, 6bm, 6baw, 6bvf, 6bvg, 6bua, 6bik, 6beo, 6buo, 6bka, 6bwp, 6cu, 6cc, 6cbi, 6cgw, 6caj, 6ek, 6en, 6fh, 6ff, 6ft, 6ec, 6ea, 6eb, 6gx, 6hv, 6if, 6iv, 6ka, 6lv, 6nn, 6ny, 6ol, 6oh, 6rm, 6rr, 6sf, 6su, 6ti, 6tw, 6wh, 6xad, 6xk, 6xa, 6xwi, 6xba, 6zh, (6zz), 6zx, 6za, 6zf, 6zo, 6zb, 6zn, 6zao, 7ad, 7aw, 7bj, 7lr, 7sc, 7tq, 7zu, 7zv, ad7, 8aea, 8azf, 8ab, 8abc, 8azq, 8azd, 8atu, 8amm, 8ft, 8aq, 8aqo, 8byo, 8ard, 8bk, 8bsy, 8blc, 8bxh, 8cid, 8cur, 8czc, 8dag, 8pd, 8qk, 8sp, 8ue, 8xe, 8yd, 8zn, 8zy, 8zw, 8zz, 9aav, 9aod, 9aou, 9abu, 9aul, 9ayu, 9apw, 9aon, 9abv, 9aps, 9avz, 9aix, 9ajh, 9aig, 9afk, 9anq, 9anf, 9asf, 9ami, 9awm, 9aap, 9aua, 9aey, 9aog, 9aex, 9awn, 9avl, 9aqr, 9aws, 9alg, 9ahh, 9atn, 9arj, 9avu, 9bm, 9bds, 9bed, 9bbf, 9bji, 9bj, 9bzi, 9bxq, 9bik, 9bkp, 9bk, 9bxt, 9bsg, 9bp, 9bzz, 9bly, 9brk, 9bgs, 9bju, 9bey, 9bkm, 9bkk, 9bsq, 9bxm, 9bx, 9cna, 9cny, 9cpu, 9cr, 9cde, 9cmk, 9cgk, 9cns, 9cuc, 9cfy, 9ckm, 9cwc, 9ccv, 9cba, 9ccu, 9ctg, 9cvo, 9cfu, 9cpa, 9cje, 9dqu, 9dkq, 9dge, 9dwk, 9dsm, 9dqm, 9dky, 9dfb, 9dgv, 9dbl, 9dz, 9dtm, 9dsd, 9dpd, 9dzy, 9dwf, 9dfq, 9dvj, 9dug, 9ebt, 9ehj, 9gk, 9gn, 9hk, 9ig, 9iy, 9ir, 9ln, 9pn, 9pw, 9pi, 9rk, 9rc, 9uu, 9ve, 9xaq, 9xac, 9yaj, 9ym, 9zaa, 9zn.

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Spk. Stas.: 4gn, 5agh, 5ag, 5acq, 5fz, 5fi, 5hz, 5jn, 5jd, 5kk, 5rb, 5ra, 5tg, 5tp, 5ud, 5ug, 5xaj, 5xa, 5xac, 5yg, 5uk, 5qs, 5zai, 9aqe, 9aso, 9att, 9bmn.

Mexican stas.: cx, jh, ax, db, cm.

Would appreciate a qsl if anyone hears my call "BX" over 1500 miles.

At 6CKC, 1201 Francisco St., Berkeley, Calif.

C. W.—1bu, 1bv, 1ht, 1ze, 2as, 3cn, 3db, 3uq, 4bi, 4bs, 4gc, 4oi, 5ad, 5bk, 5br, 5dq, 5eo, 5ew, 5go, 5la, 5mo, 5ui, 5va, 5vi, 5ado, 5adq, 5ahr, 5aom, 5apu, 5aur, 5avr, 5bug, 5za, 5zq, (5zav), 6bq, 6cc, 6cj, 6eb, (6eo), 6gg, 6ka, 6ku, 6nu, 6ny, (6tu), (6uw), (6wd), (6ael), 6aju, 6alf, 6alu, (6amk), (6aoc), 6aoi, (6asv), 6atg, 6avh, 6avn, (6avu), 6bae, 6bah, 6bak, 6baw, 6bdf, 6bdq, 6bds, 6bfr, 6bga, 6bgy, (6bjj), (6bjr), (6bjs), (6bjq), 6bic, 6bih, 6bik, 6bip, 6bis, (6blm), 6bmd, 6bpc, 6bpz, 6bqc, (6bqd), (6bqr), 6bqw, 6bra, 6brj, 6bru, 6bsz, 6buf, 6bug, 6bum, 6bun, (6buo), 6bve, 6bvg, 6bvr, (6can), (6caz), 6cim, 6cuo, 6cbu, (6ceu), (6cje), 6cgw, (6zf), 6zh, 6zz, 7ab, 7ak, 7ag, 7am, 7au, (7bj), 7bx, 7dn, (7ge), 7gf, 7gl, 7hb, 7hm, 7ib, 7jb, 7jk, 7jl, 7li, (7ln), 7ls, 7mc, 7my, 7na, 7ne, 7nf, 7nt, 7oi (7om), 7ow, 7qw, 7rk, (7ri), 7rm, 7sc, (7sf), (7sn), 7ss, 7to, (7tq), 7ut, 7ve, 7ve?, (7vr), 7vt, 7wk, 7wm, 7wn, 7wx, 7xt, 7zf, 7zg, 7zu, 7zv, 7abb, 7abh, 7acx, 7adc, (7adp), 7aea, 7all, 7amk, 7aps, 7auo, 8bc, 8bw, 8er, 8gd, 9au, 9bx, 9ee, 9op, 9tc, 9vn, 9xb, 9xm, 9xt, 9bai, 9bjj, 9bji, (9bjy), 9btl, 9bwi, 9bxq, 9cns, 9ccw, 9ccv, 9dkq. Canadian—5go, 5ct, 9bx. Specials—ad7-"ra" (Argentina Amateur).

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By Wm. McKay, 1495 N. Van Ness Ave., Fresno, California

5sf, 6aaj, 6acm, 6ael, 6ahu, 6amk, 6anh, 6ao, 6aoi, 6apl, 6arf, 6atq, 6auu, 6aw, 6awh, 6awt, 6bah, 6baw, 6bcj, 6beo, 6bfl, 6bih, 6bip, 6bjj, 6bjq, 6bk, 6bl, 6bm, 6bmd, 6bmp, 6bod, 6boe, 6bou, 6bpt, 6bqc, 6bqd, 6bqe, 6bqw, 6brf, 6bri, 6bs, 6bsq, 6btw, 6bu, 6buf, 6buh, 6bum, 6bun, 6buo, 6buv, 6bv, 6bvf, 6bvg, 6bvu, 6bvw, 6caj, 6can, 6cc, 6ccb, 6ceb, 6cfq, 6cfu, 6cga, 6cje, 6dt, 6ea, 6ec, 6fc, 6ff, 6fy, 6iv, 6jd, 6ju, 6jx, 6ku, 6lu, 6my, 6nx, 6qk, 6ti, 6xa, 6xk, 6zd, 6ze, 6zh, 6zl, 6zo, 6zt, 6zz, 7adg, 7aft, 7ak, 7eq, 7ey, 7ge, 7io, 7js, 7lr, 7my, 7nf, 7oe, 7pf, 7ri, 7tq, 7ws, 7wx, 7xf, 7xi, 7yg, 7zv, 8cyu, 8dz, 9aap, 9als, 9auw, 9avu, 9ayd, 9bbt, 9bgy, 9bji, 9bri, 9bx, 9bxk, 9bxm, 9caa, 9deh, 9dgw, 9djb, 9dvj, 9dxj.

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NEWS OF THE BROADCASTERS

Super Radio Station Opens at Aeolian Hall May 15th

Broadcast Central, the new radio station of the Radio Corporation of America at Aeolian Hall, which has been the subject of considerable speculation among radio listeners who have heard the station testing with call 2XR, will be opened May 15th.

Located in the heart of the city's musical and theatrical district, where entertainment of the highest order is ever available, this station will offer to the American public the most elaborate radio programs with a degree of faithfulness in reproduction that marks the beginning of a new era in radio broadcasting. The wires which tower 400 feet above the street on Aeolian Hall, at Fifth Avenue and 42nd Street, provide two antennas, and this super-station will transmit two broadcast programs simultaneously, on different wavelengths.

The closing of station "WJZ" at Newark, N. J., now operated jointly by the Radio Corporation of America and the Westinghouse Electric & Mfg. Company, will coincide with the opening of Broadcast Central. The well-known call "WJZ" will be retained for transmission from the Aeolian Hall station on 455 meters, while the call "WJY" will be used for the other wavelength of 405 meters; both of which wavelengths have recently been allocated to the new station.

The new station is fitted with a double antenna and two independent transmitters which will permit a dual program to be broadcast, one, that of classical or serious entertainment; the other, popular airs, dance music and lectures.

The Radio Corporation of America has made a thorough analysis of the types of programs best suited to the requirements of the public and this study has revealed the fact that, generallly, the radio public may be divided into two classes—those who prefer classical or similar entertainment, and those desiring dance music and popular airs.

Not only will transmission be carried on from the two studios which are a part of the station, but the main recital hall of Aeolian Hall has been connected to a switchboard in the station, thus providing at frequent intervals another source of the finest music obtainable.

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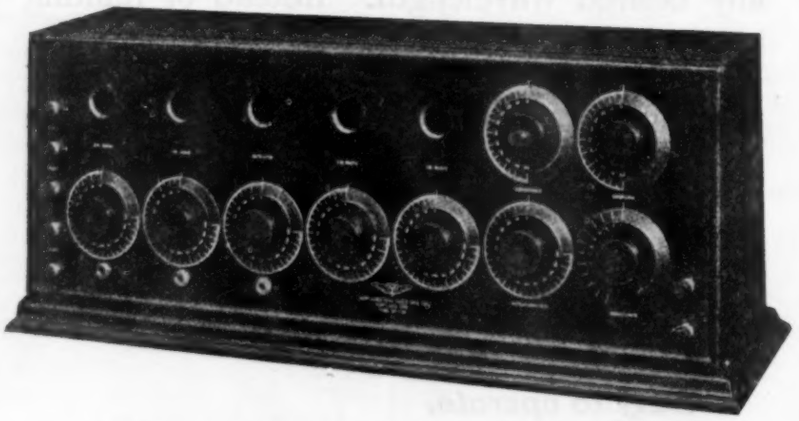

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RECEIVING SET DESIGN

Continued from page 15

fastened to the panel by means of two brass bolts and then connected to ground, that is, to the ground lead of the set. Care must be taken to make sure that no metal or "live" parts of the condenser are in contact with the condenser shield, or the whole tuning elements will become short circuited. The purpose of the shields of course is to minimize capacity effects when the hand is brought near a dial.

After all the holes have been drilled in the panel, all the necessary markings are made thereon. Marks are made for dial number references. The writer makes an indentation with a chisel and fills this with chalk or white lead. Names may be stamped on with letter punches and also filled in the same way, or better, suitable name plates may be attached.

Next all the parts that go on the panel are assembled, rheostats, condenser, shields, jacks, switches, switch points and stops, with the exception of the tuner. After the taps of the tuner are soldered to the right points, the tuner may be fastened to the panel.

The panel is then temporarily screwed to the sub-base and the sockets and transformers are placed thereon and arranged as per the sketch, proper allowance being made for the wiring of the jacks. The positions of the screw holes of these parts are now marked and the panel removed. The sockets and transformers are now screwed down to the base in their right positions. (We assume that this base has been stained and finished at the same time that the cabinet was). Little binding post blocks as shown in Fig. 2 are made up from pieces of scrap panel material, these are also screwed in place.

Next it is advisable that as much wiring be done as possible, both on the panel and on the sub-base. After this is done the panel is screwed to the sub-base and the wiring completed. Because of lack of room it would be very difficult to wire the set in one operation.

In wiring amplifying transformers it is quite important that the grid, plate, positive *B* battery, and filament leaks be soldered to the correct posts. These directions are usually furnished with each transformer. In general the outside lead of the secondary goes to the grid of the next tube, and the outside of the primary winding to the plate of the tube. There may be a few exceptions to this, but it is true for most makes of transformers. If these instructions are not followed poor amplification will result and often serious howling. Since no *C* battery is used it is also very important that the other end of the secondary is connected to the *negative* side of the *A* battery. Rheostats, for the same reason, are also generally connected to the negative side

of the filament, thus providing a little more negative biasing. With the average tube that burns at almost full brilliancy this is not very important.

Too much care and thought cannot be exercised in wiring in order to assure a neat appearance. Each piece of wire is bent to the correct shape and cut to the right size before soldering. Make all bends sharp and at 90°. The job looks much neater if each piece is covered with varnished cambric tubing ("spaghetti"). In this case cut the tubing to the correct length first, place over wire, then bend. If there are only one or two bends no great trouble will be experienced if the tubing is put on last, but if there are a number of bends required, put tubing on first.

In order to insure that the soldered joint be neat and strong, be sure that the iron is clean and well tinned. Put a small amount of soldering paste on the joint, pick up a little solder with the point of the iron, and touch the joint to be soldered. In a few seconds the solder will flow to the joint. Remove iron and hold joint in place if necessary until it cools. A neat and strong joint will result.

No. 14 hard drawn copper wire is ideal for wiring because of its stiffness. However, there is now on the market square tinned copper wire, which, although somewhat expensive, makes a beautiful job if carefully done.

The set, now being wired, is ready for a tryout. Make all necessary external connections. Turn the rhostats to the off position first in order to save the tubes if a serious mistake has been made. When all connections are made turn rheostats on slightly. Now try pushing the plug into the various jacks to see if the filament control system is in working order. Next place plug in detector jack and adjust filament and *B* battery until set is working well. Then try out each amplifier in order. If each stage produces proper amount of amplification with proper filament adjustment and reasonable amount of *B* battery (say 45—90 volts) then the set is all right and it may be disconnected and placed in the cabinet and screwed to the sides. If some part does not function, the trouble is immediately detected and corrected. The most common sources of trouble are (a) wrong wiring, (b) reversed polarities, (c) wires omitted, (d) "opens" in transformer windings. (a) (b) and (c) can be found by inspection, and (d) can be found by sparking each winding with a *B* battery.

Many beginners find it hard to "tune-in" stations quickly. The following hints may be of value. Try about 40 turns to start with and throw the tickler coil over past the hissing point. The detector tube is now oscillating. If the condenser is now turned slowly, at a certain position a "whistle" will be heard (if one

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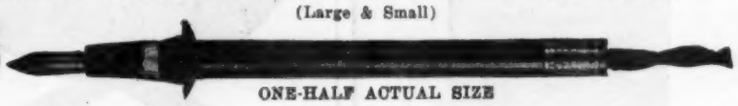

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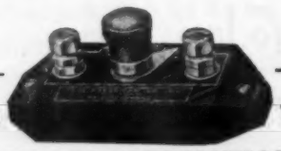

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cannot be heard try either more or less turns). This indicates that some sort of undamped wave station has been tuned in. Now come back on the tickler slowly, and follow the "whistle" at the same time with the condenser. It must now be apparent why a 23 plate condenser is more suitable than a 43 plate type. When the tickler has been turned back until oscillation ceases the station will be heard and then it is a simple matter to adjust the tickler and the vernier of the condenser for maximum response. Never try to get distant stations by leaving the tickler in the zero position (all out) and tuning with the condenser only. A set then is non- regenerative. We do not mean to say that this is the only way to tune a set but the writer has found it to be a quick and practical way and has always used it. For adjusting the detector tube, throw the tickler out into a *non-oscillating* condition and turn up rheostat until hissing begins, then turn back until quiet. When first putting a new tube into operation try this with various values of *B* battery noting signal strength each time; use the combination that gives maximum response, of course. It is well to check this adjustment every week or two because the *B* battery voltage may have dropped, or the characteristic of the tube may have changed a little with use.

Tuner Construction

The tuner in this set was made up of a variometer and a loading inductance. The variometer was taken apart and the wire that goes from the stator to the rotor disconnected. A lead was then connected to the rotor at this point and brought out to one of the screws that hold the variometer together. The remaining free end of the stator was brought out to another one of the free screws. It is well to use the two bottom screws for affixing the rotor leads, as this will facilitate the wiring later on and will also prevent mistakes and confusion when the variometer is reassembled. In any case they should all be marked in some way.

Before reassembling, a lead is also connected to the point where the two stator windings are soldered together. Make a small groove in the stator with a file so that the wire can be laid in this when placing the two halves of the variometer together.

Brackets are next made from heavy brass stock, two for mounting the tuner on the panel, and two for mounting the loading inductance on the variometer. The latter brackets are mounted by means of the screws on the diametrically opposite corners of the variometer and are so bent that the tube fits singly between them. See Fig. 4 a, b, c.

For the loading coil, a 3-in. tube (formica) 5½ in. long was used, wound with about 150 turns of No. 26 D. C. C.

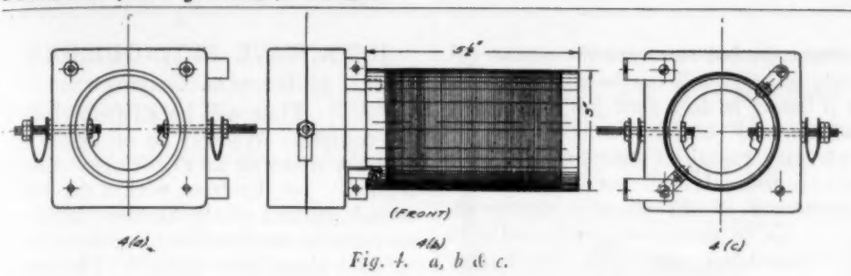

Fig. 4. a, b & c.

wire. (Green silk would have made a much nicer appearance). A space of about 1 in. was left at the end nearest the variometer in order to leave room for the brackets, and a ½-in. space was left at the other end. Before winding, it is well to drill the necessary holes for mounting and for anchoring the ends of the coil, two small holes being used for this latter purpose, the end of the wire being pushed in one and out the other. The easiest way, of course, to locate the bracket holes is to put the tube in place, see that it is straight and mark the holes by means of the holes in the brass brackets.

The inductance is wound as follows, this method giving the best results:

Taps	Turns per tap
1	10
1	15
1	20
1	25
1	35
1	45
Total 6 taps	150 total turns

7(a)

7(b)

Fig. 7. a & b.

If the builder intends to receive broadcasting only, he need put on only about half this amount of wire and may cut down the size of the tube to correspond. See table given below. If more turns are desired it will be necessary to use bank winding because the length of tube should not exceed 5½ in. in this set.

Winding Data for Tuners

(Approximate)

Based on average antenna and .0005 mfd. (23 plate) variable condenser in antenna lead.

Range in Meters Wavelength	No. Turns No. 20 D.C.C.	Length Tube
180—— 260	20	None ½ stator
180—— 370	40	All stator
180—— 500	60	3"
180—— 800	150	5½"
180——1000	250	5½" double bank
180——1500	350	5½" triple bank

It will be noted that this table is given for No. 20 D.C.C. This will be a little more efficient and easier to use than No. 26. This table is given for those who may wish to depart from the description of the tuner given. The table is for total number of turns. Most variometers have about 40 turns on the stator, so this figure is deducted to get the number of turns required on the loading inductance. The table is not based on mathematics but on experience and observation. Conditions vary too much to warrant the use of a mathematically accurate table.

Figures 7 (a) and (b) show how a bank wound coil is made. The tube must be either roughened, grooved, or taped in order to prevent the wires from slipping apart when winding. There are

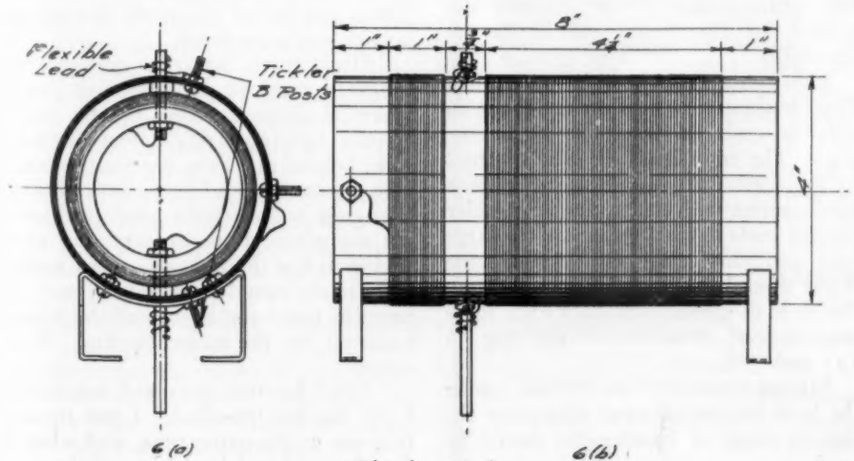

Fig. 6. a & b.

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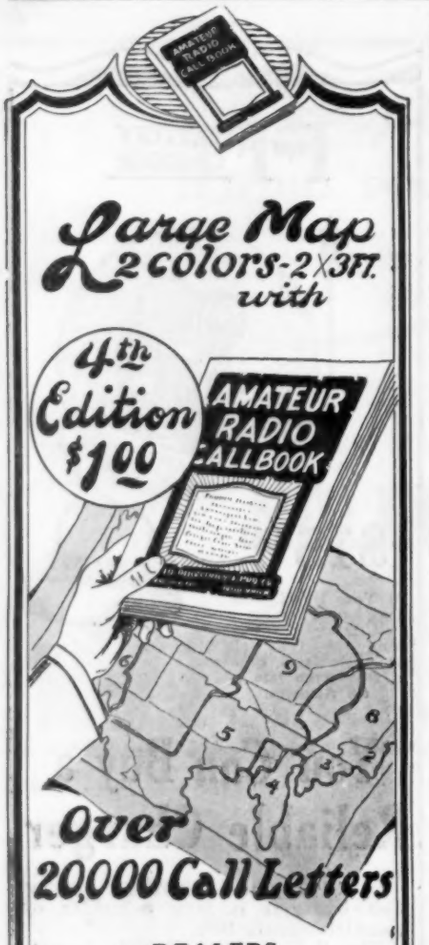

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other ways but these are the easiest. A little practice will not be amiss, because it is harder to do a good job than it may seem.

It may appeal to some to build their own tuners. It will not have the nice appearance of the above arrangement, but it can be made quite neatly and with no more labor, and with considerably less cost. A fibre, formica, or bakelite tube 4 in. inside diameter and about 8 in. long should be procured. A standard 3½ in. bakelite ball and ¼ in. shafts to match are also bought. The rotor is filled with about No. 22 D.C.C. wire or any suitable size so that 15 to 20 turns are wound on each half. The correct size will depend on the amount of room on the rotor, but No. 22 is a good guess for the average rotor sold. Wind only one half at a time starting from the outside and winding towards the center, and of course wind in the same direction so that a continuous winding results when the two center leads are soldered together. A good way to prevent the outside ends from becoming loose is to put a drop of solder on the leads where they emerge from the holes in the rotor, and as close to the wall of the rotor as possible. These leads are soldered to the rotor shafts only after the tuner has been completely assembled.

The tube is now drilled. Holes are made for mounting brackets on each end. The holes to pass the ¼ in. shaft are drilled about 2½ in. from one end. Great care must be exercised here to insure the shaft running true when the tuner is mounted. For the same reason the brackets must also be very carefully constructed. In order to allow clearance for the bracket and the rotor shaft the winding starts 1 in. from the rotor end and stops after an inch of single layer winding has been put on. (No. 20 D.C.C. or D.S.C.). Leave a lead of about 8 in. and then begin a new winding about ⅜ in. beyond the center of the rotor shaft hole. Using the data given in the winding table (this will be close enough for a 4 in. tube) wind as many turns as desired, taking taps either evenly, or in the way described for the tuner used in the set described.

The rotor may now be assembled. Brass bushings are used on the shafts in order to space the rotor and to prevent play. The rotor leads are now soldered to the shaft. An easy way to make a good contact with the tickler is to solder flexible leads to the shafts near the large tube and wind these leads around the shafts several times (loosely) and clamp the ends to binding posts. Other ways may suggest themselves. See Fig. 6 (a) and (b).

Always remember that for best results the least number of turns that cover the desired range of wavelengths should be used.

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"Get them that clear?" This to a group of fans, who frequently graced his "lab."

"Can't say that I do. That new filter device of yours sure pulls out the squeeks." The speaker, one of the aforementioned fans, rose to take a look at the recent addition to Joe's receiver.

"Yeah, I ought to make quite a pile on that. So simple, y'know, but it does the work OK.

"Old stuff! That's what all these inventors say. 'I ought to make a fortune on this one.' When you go broke come around and I'll lend you a couple of dollars."

"You don't believe it, huh? Why, I —say, did I ever tell you about that wave-extinguisher I developed during the war? The only reason I didn't make anything out of that was that it was too darned efficient."

"Never heard of it. Give us a line on it now, while you're still good natured."

"Well, back in 1914, I got my big hunch. I figured, that if a station could be built which would create waves and send them out in all directions, why wouldn't it be possible to make a set which would absorb all waves? Why couldn't some piece of apparatus be made which would draw all the waves in the ether towards it, the same as a whirlpool draws all objects on the water towards its center? Nobody had thought of it then.

"You know how much more dope we've had to work on since the war, so you can imagine what a time I had getting started. I tried lots of things which look silly to me now, before I got on the right track. But, after the start, problems cleared themselves up in quick order, and by the time the United States got mixed up in the big scrap, my set was completed.

"After tests for the government agents, I received permission to give a practical demonstration of the outfit on the fighting fields. The German spies behind our lines were using portable phone sets, and by means of codes, changing wavelengths and positions, got the goats of the experts who were trying to run them down. All I would have to do would be to put up my set near the front and absorb all the waves radiated by the spies' outfits. Very simple!

"Aided by two recruited assistants, I got the set installed. I put up my receiver at the same time, and when I first listened in I heard one of the fun-

niest things that ever came to my ears. I'd hear a snatch of speech here, then it would vanish. Tuning to a different wavelength, I would hear the voice there, but only for a few seconds at a time.

"Now was the time for the 'show-'em stuff.' I pulled down the power switch. The filaments lit up, and the little set started 'perking' in good order. I took up the receivers again and put them on my head. Not a sound.

"No doubt," I thought, "those dirty Huns are wondering what's the matter with their infernal outfits."

"Well, as I said before the set worked more efficiently than I expected, for, as I afterwards found, it took in the waves faster than the transmitters could send them out. What then? Believe me or not, when those waves didn't come in fast enough, boy, we actually pulled the current out of those German batteries. But that wasn't all. What d'you suppose happened when the batteries ran down? Man, the force of that little instrument picked up battery, set, Hun, and all and shot them through the air to the center of our etherical whirlpool. Long Huns, short Huns, fat Huns, lean Huns, all draped themselves more or less gracefully over our aerial.

"I tell you, that aerial wasn't built for a human clothes-line. Pop! goes all the wires and plunks about twenty German spies down on my wonderful set.

"Now comes the tragedy part of the story. One of those Fritzies fell right smack on top of my inductance. That inductance just flattened out like a bedspring when a 500-lb. individual reclines thereon. Every turn was shorted out. The aerial was grounded too. You can imagine the effect this would have on the rest of the set. Instead of eating up waves of a relatively high length, that extinguisher was making a good meal out of our own *voice waves*. We could see each other's lips moving, but not a word, cuss—or otherwise, could we hear. Lord, what a sensation. Imagine standing in the middle of a bunch of half-conscious German spies, trying your hardest to talk, straining your ears for a single word, and yet everything being as silent as midnight in a cemetery.

"But we came to pretty soon. One of those German rascals woke up, grabbed the plans and circuit diagram of my set, which were laying near him, and beat it out the door, leaving us standing there gaping at him. Then I snapped out of it. I ran over and turned off the power. Immediately our voices came back. I chased out of the door after that filthy rat of a Boche. No use—he was gone, and with him went all the earthly knowledge of my set. No, I still had the apparatus itself, I thought.

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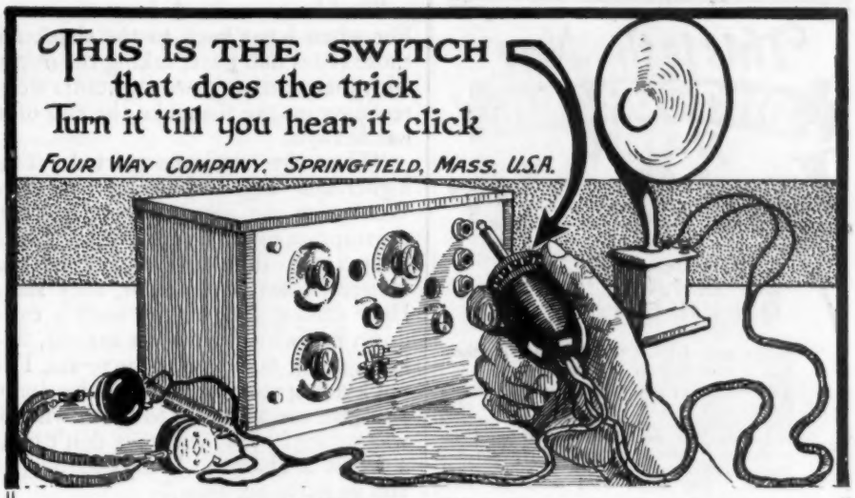

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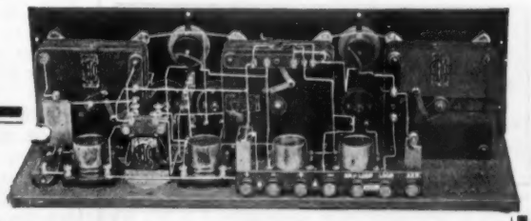

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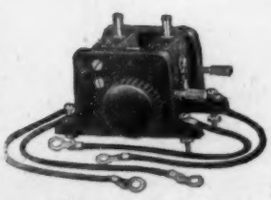

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HAVE YOU READ
Page 65 ??

"Bad luck was headed my way sure. For when I got back to the shack all those Huns had gone, taking the outfit with them, and my two assistants were reclining on the floor like the end of a battle royal.

"Then the hurricane started. The higher-ups began jumping on me. What was the idea of bringing that contraption over there anyway? I had wasted the time and money of the United States government, they said. Holy smoke, I never got such a call-down in—why, what's the matter, fellows, going now? Why, say—no, I'm not kidding you. It really—why don't you give me a chance to finish what I was saying? Aw, you guys don't give a fellow a chance. Well, goodbye, if you've gotta go, then."

Joe turned back to his knobs with a grunt. "Huh! Don't some guys give you a pain. Bet they didn't have any date at all. Gee, you can't believe a thing some guys say!"

RADIO STATION 9ZT

Station 9ZT at 54 Penn Ave. N., Minneapolis, Minn., has been in operation since the beginning of 1923, and consistently works all districts, both coasts, and handles a fair amount of traffic, the total for March being 308. It is operated almost exclusively by the owner, D. C. Wallace.

The antenna system consist of 6 wires, 50 ft. long on 12-foot spreaders, supported by two masts 60 ft. and 85 ft., respectively.

The counterpoise is radial, similar to the spokes of a wheel, and consists of 25 wires at the height of 8 ft. Each wire is 100 ft. long, so the entire counterpoise covers a circular area 200 ft. in diameter.

The radio room is in a five-room bungalow. When the foundations were laid, a radial ground system was put in, so as to cover almost the entire lot. This ground system was proven of no use whatsoever, but there is a certain satisfaction in knowing that a good ground will not help in this particular instance.

The transmitter consists of one UV204 radiotron supplied with ac on the filament and rectified ac on the plate. An electrolytic rectifier of 120 jars is located in the basement immediately under the station. The transformers for supplying the ac to the rectifier are also located in the basement.

The filter system is made up from 20 UV490 condensers, and one filter reactor.

The circuit in use at the present time is a Hartley, giving radiation of 6 amperes on 100 meters, 10 amperes on 200 meters, and 10 amperes on 375 meters. A large size oscillating transmitter for use in the Meissner circuit is under construction.

It is very easy to change from sending to receiving, as one short action switch completes the entire operation by one slight movement. Break-in system was tried, but found to be illogical on such high power.

The receiving set is the usual single circuit design, utilizing two wave traps—one in series with the antenna, and the other coupling the antenna to the single circuit set. This arrangement has proven most successful, in view of the fact that there are some 200 transmitting stations in the immediate vicinity, and some dozen or so high power within a few blocks.

A short vertical single wire 50 ft. over all in length is used for receiving, as it proves extremely selective, and in addition, makes an excellent antenna for work on 100 meters.

A wave meter is used to check both receiver and transmitter, and at the same time the picture was taken, as is usually the case, a new type of receiving set was under the process of construction. This can be seen at the left of the picture, under the stack of cards received.

The transmitter is connected for use as a phone station by means of the magnetic modulator if desired.

The operator has been in commercial service with the old Marconi Company, the Navy, and at present holds a first-class, first-grade commercial license. The station is an official American Radio Relay League station, and has worked the west coast 18 out of the last 20 nights in operation. A schedule was maintained for two weeks with IQP before dinner in the evening. This was a very reliable schedule, as can be vouched for by the assistant editor of *Q. S. T.*

9ZT has a very pleasant operating atmosphere, and is open for relay work during a portion of practically every night between the hours of midnight and 7 A. M.

D. C. Wallace, Owner and Operator of 9ZT, at the key.

THE NEW DRY BATTERY TUBE

A new and improved detector and amplifier tube designed especially for dry battery filament current supply is being manufactured by the General Electric Co. and is being distributed by E. T. Cunningham as the C-299 and by the Radio Corporation of America as the U. V.-199. It is interchangeable with and may be used in any circuit designed for other types of tubes provided suitable filament supply voltage and rheostats are used.

This new tube contains a special "XL" filament having a current consumption of 60 milliamperes (.06 amperes) at 3 volts, a power consumption of only .18 watts. The filament has a very low operating temperature and failure is seldom due to actual burn-out, unless excessive voltage is applied. The end of the useful life of the tube is indicated by a decrease in the electron emission from the filament, or by the necessity of using an increased filament terminal potential in order to obtain satisfactory results.

The filament current should be supplied from three standard No. 6 dry cells in series, with a suitable rheostat. From three to five tubes may be operated in parallel from a single set of three batteries in series. Six dry batteries connected in series parallel will prove more economical when more than three tubes are used.

The filament current is not a critical factor in the operation of this new tube, and it is only important that it is not allowed to exceed the rated value of 60 milliamperes. For this purpose a special high resistance rheostat must be used. The terminal potential of dry cells varies widely with the load, or amount of current drawn from them, and the maximum resistance of the rheostat will, therefore, vary with the number of tubes used in parallel on one set of batteries. For a single tube, supplied by three No. 6 dry cells in series, the filament rheostat should have a total resistance of 30 ohms. For two tubes in parallel the total resistance of the rheostat should be at least 20 ohms. When using 3, 4 and 5 of these tubes in parallel a single rheostat, having a maximum resistance of 10 ohms may be used.

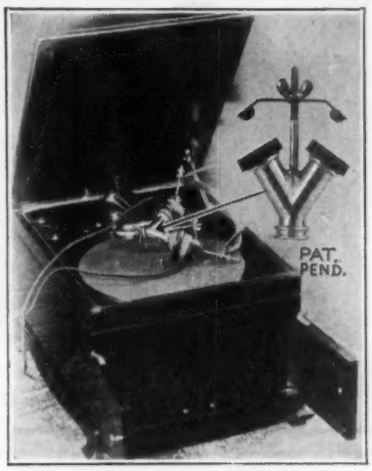
For best results as a detector a potential of approximately 40 volts should be used, although very satisfactory detector action can be obtained with a single 22½-volt battery for plate supply, and its use will tend to increase the active life of the tube. Never apply a potential of over 40 volts to the plate when the tube is used as a detector.

The tube may be used with very satisfactory results in a multi-stage radio-frequency amplifier and for one or two stages of audio-frequency amplification. It is not recommended that this tube be used for the operation of large loud speakers, but when used in a well-designed two-stage amplifier the output will be sufficient for the operation of small loud speakers. When the loud speaker is connected directly to the plate circuit its impedance should be about 20,000 ohms. This is the approximate value of the tube impedance. When used as an amplifier it is extremely important to have the filament rheostat in the negative filament lead, and to have the grid return made to the negative side, between the negative battery terminal and the rheostat, instead of between the rheostat and the filament terminal, as has sometimes been done in the past. These connections provide a negative bias for the grid of the tube which is sufficient for all plate potentials up to 40 volts. For obtaining the highest quality of signals and maximum life from the tube, this negative potential should be increased with an increase in plate voltage. The following table gives an approximation of the grid bias voltages necessary for various plate voltages:

40-Volt Plate.....	0.5-1.0 Volts Neg. Grid.
60-Volt Plate.....	1.0-3.0 Volts Neg Grid.
80-Volt Plate.....	3.0-4.5 Volts Neg. Grid.
100-Volt Plate.....	4.5-6.0 Volts Neg. Grid.

For this purpose extremely small dry cells, such as are commonly used in the small type of flashlight, will be found to be very satisfactory. These cells commonly called "C" battery, should always be placed in the grid circuit between the filament return and the secondary of the transformer.

"Radio Hook-Up" is the subject of a neat booklet from the Rauland Mfg. Co., Chicago, Ill. It will be sent for a 2c stamp. After a preliminary description of the principles of radio and radio frequency amplification, 22 approved hook-ups are given.



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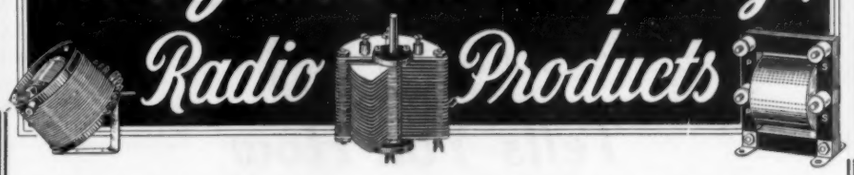

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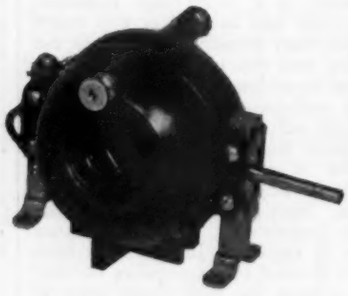

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"RADIO" Pacific Bldg. San Francisco

Statement of the Ownership, Management, Circulation, Etc., Required by the Act of Congress of August 24, 1912,

Of "RADIO," published monthly at San Francisco, California, for April 1st, 1923.

State of California,
County of San Francisco—ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared H. W. Dickow, who, having been duly sworn according to law, deposes and says that he is the business manager of the "RADIO," and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Pacific Radio Publishing Co., Inc., Pacific Building, San Francisco, California.
Editor, Arthur H. Halloran, Berkeley, California.
Managing editor, none.
Business manager, H. W. Dickow, San Francisco, California.

2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of each, should be given below; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent or more of the total amount of stock should be given.)

Pacific Radio Publishing Co., Inc., Pacific Building, San Francisco, California.
A. H. Halloran, Berkeley, California.
H. W. Dickow, San Francisco, California.
H. L. Halloran, Berkeley, California.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

H. W. DICKOW,
Business Manager.

Sworn to and subscribed before me this 23rd day of March, 1923.

(Seal) J. D. BROWN.
Notary Public in and for the City and County of San Francisco, State of California.
(My commission expires April 4, 1926.)

RADIO DEVELOPMENT IN SWEDEN

Mr. Siffer Lemoine, radio engineer of the Royal Board of Swedish Telegraphs, has spent the past two months in the United States making arrangements for the delivery of apparatus and equipment for the new high-power radio station to be erected at Goteborg. The contract for this equipment, which was secured by an American company in competition with British, French, and German bidders, provides for the supplying of a 200 KW Alexanderson generator, with all necessary equipment and apparatus, and plans and specifications for complete installation. The steel towers to be erected for the antennae will be similar in height and arrangements to those used in the latest American high-power radio stations, but the actual design of the towers and the material will be furnished by a Swedish firm. It is expected, according to information received by the Department of Commerce, that the installation will be completed and the initial tests made before the end of the year.

Goteborg is the most important communication center in Sweden, since it not only is the site of the proposed high-power radio station, but is the terminus of the cables from England and Denmark, as well as of the toll cable to Stockholm. The new station will be operated by the Royal Board of Swedish Telegraphs. A direct circuit will be established with the Rocky Point station of the Radio Corporation of America, thus providing the first direct radio communication between the two countries. It is believed that the traffic handled will be of sufficient volume to make a satisfactory return on the investment.

As Sweden has no extensive international cable system and has hitherto relied on foreign countries for all of its international communication except that with its immediate neighbors, it is probable that the Swedish Government will afford every facility to the new station for the rapid and efficient handling of international telegraphic business, particularly with the United States and other distant points. The modernization of the Swedish telegraph system, which has been proceeding steadily for the last three years, will aid materially in the proper handling of trans-oceanic radio traffic to Stockholm.

The Radio and Research Club of the Springfield (Ill.) High School recently conducted some successful transmitting and receiving tests 250 ft. underground in the Woodside Mine. With a 10-watt C. W. transmitter in the mine signals were heard at a home several miles distant and two-way communication established. Many other signals were received underground, including 8ao, 8bmg, 8fm, 8bm, 9ecz, 8wx and 9dbo.

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FOR SALE—R-3 Magnavox. Guaranteed good as new. First money order for $33.00 takes. H. S. Ogden, 2924 Leeward Ave., Los Angeles, Cal.

SARSON COMPOUND CORE
Tuned Radio Frequency Transformer.
Guaranteed to give excellent results.
$4.50 complete with hook up.
Santa Rosa Radio Shop
Santa Rosa, Calif.

This ONE TUBE hook-up received CUBA, besides 10 DX stations. Blue prints, diagrams, 50c. Marchese, Box 417, Brooklyn, N. Y.

Edison Storage B Battery Elements, 5 cents per pair. First grade elements only. J. Zied, 530 Callowhill St., Philadelpnia, Pa.

Complete mounted Tube set tested over 500 miles before shipped; $12 without Phones or Tube. Arthur Richardson, Box 85, Baltimore, Marvland.

200-20,000 Meter Receiver, including radio-tron, $35.00. Two-step Amplifier, $25.00. Box 205, Williamsport, Pa.

LIGHTNING — STRANGE BATTERY COMPOUND. Charges discharged batteries instantly. Eliminates old method entirely. Gallon free to agents. Lightning Co., St. Paul, Minn.

NEUTRODYNE radio frequency transformers, for broadcasting, each $2. Guaranteed to work. RAYDEE-ARTCRAFT INSTRUMENT CO.,1017 Tribune Street, Redlands, Calif.

A COMPLETE RADIO CODE COURSE
The only course of its kind offered in the United States. Teaches you quickly to transmit and receive code for a radio operator's license or for your own pleasure, explains methods of calling other stations and how to receive messages, gives abbreviations used in messages, gives examples of how they are used in commercial messages, secret codes and how to use them and all the necessary information to understand and record all the different messages which are being transmitted in code. Complete course sent upon receipt of $1.00 (bill, check or money order, no stamps) with the understanding that if the course is not exactly as represented your money will be refunded. Get your course today. National Radio Institute, Dept. IC, 1345 Pennsylvania Avenue, N. W., Washington, D. C.

ONE TUBE NEUTRODYNE-REFLEX circuit with number of turns on coils, capacity of condensers, etc., mailed for a twenty-five cent piece and two-cent stamp. It works!! Six Zee Jay, 1017 Tribune St., Redlands, Calif.

THE CHANCE OF A LIFETIME—Grebe CR-5, $50.00; Federal Type 55 2-stage R. F. Amplifier Unit $40.00; Exide Storage Battery, 80 amp. hour, $20.00; Kennedy 218; $60.00; Kennedy 521 Amplifier, $40.00; Dictograph phones, $6.00. Write for list of bargains priced low for quick sale. All in A-1 condition. B. W. Casselberry, 620 Plumas Street, Reno, Nevada.

Turn It Into Cash

Only 5 Cents a Word

Sell the spare radio supplies that you have on hand. Use the "RADIOADS." Get quick and profitable results. "Exchange" Radioads also accepted.

What have you for sale or exchange?

MAIL YOUR "RADIOAD" TODAY

Tell them that you saw it in RADIO

THE VARIOHM

The Variohm is a variable high resistance ranging from 1-10 to 5 megohms. Any resistance between these wide limits is availabel by simply turning the knob. No sliding contacts play over the resistance elements itself. The contact is produced by a second member which the slider causes to press down or lift up from the resistance element.

The Variohm

The change in resistance is brought about gradually and smoothly. Mathematically, there is an infinite number of resistances available. Encased with the Variohm is a standard mica condenser of correct and permanent capacity. The Variohm is absolutely moisture proof and is supplied with a bakelite case, size 2 13-16x7-16 inches.

BOOK REVIEWS

"Amateur Radio Call Book," published by Radio Directory & Publishing Co. of New York City. Price $1.00.

This book lists the call letter of over 20,000 stations in the United States and Canada, so that you can tell at once the location of the station sending the message, whether it is amateur, commercial, army, navy, transoceanic, high powered, or broadcasting station. Progressive amateurs will be especially interested in the construction and operation of the Reinartz tuner, detector, and one-stage amplifier, as described in the book, for the Reinartz circuit is rapidly becoming known as one of the most efficient circuits available for radio owners operating sets of their own construction.

Perhaps the most attractive feature of the book is the splendid two-color map of the United States and Canada, 2 x 3 feet, showing radio district boundaries, standard time lines, geographical location of broadcasting stations, etc., as well as containing an alphabetical list of broadcasting stations.

"101 Receiving Circuits" by M. B. Sleeper, 48 pp., 6 x 9. Published by M. B. Sleeper, Inc., 88 Park Place, New York City. Price 50c.

This is a second edition of a useful compilation of hook-ups, including not only the older crystal, audion and regenerative circuits, but also the newer reflex Neutrodyne, Reinartz, Flewelling, super-heterodyne and super-regenerative. In each case is given a circuit diagram and explanatory paragraph.

"Six Successful Radio Sets" by M. B. Sleeper, 48 pp., 6 x 9, published by M. B. Sleeper, Inc., 88 Park Place, New York City. Price 50c.

Herein are given design data and instructions for building five receiving sets of different types and a two-stage audio-frequency amplifier. Several photographic views, together with circuit diagrams and constructional details are given for each set.

A kite balloon for suspending an aerial has been successfully tried out by R. W. Coburn and Roy Knabenshue at Burbank, Calif. A balloon 14 ft. long, 4 ft. in diameter and holding about 40 cu. ft. of hydrogen suspended a 200-ft. aerial.

De FOREST CO. PURCHASED BY JEWETT

The entire business, good will and patents of the De Forest Radio Telephone and Telegraph Co., has been purchased by Jewett Radio & Phonograph Co., of Detroit. The purchase includes 181 radio patents, among which are the basic right to the three electrode audion bulb. Among the other patents are several covering radio equipment in general use as well as a large number representing more recent developmental research by Dr. Lee De Forest which embodies startling new developments in the radio field.

The purchase also includes an extensive new plant of the De Forest Co., at Jersey City, N. J., which is the largest individual plant in the world, devoted solely to radio manufacturing. At this plant De Forest inventions are manufactured commercially.

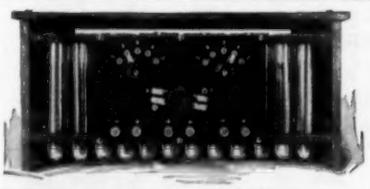
According to Mr. Edward Jewett, Dr. De Forest will continue his activity with the company as consulting engineer and a large share of his attention will be devoted to the perfection of equipment by means of which the human voice may be synchronized and reproduced in conjunction with moving pictures; thereby adding a widened range of interest to the hitherto "silent drama."

VARIABLE RESISTANCE LEAKS

A decided improvement has been made recently in the Variable Resistance Leaks manufactured by Chas. Freshman Company, Inc., of New York City. One of the most important improvements is the fact that the graduations of resistance are made more uniform, and the range over which the contact moves has been increased from 90 to 180 degrees.

The base of the leak is of specially treated fibre, while the leak path is composed of some high resistance material impregnated into the fibre, a feature for which Freshman claims exceptionally long life. This leak path is waterproof and is covered by a bronze spring rotated by a small knurled composition handle.

Alteration in resistance due to atmospheric changes is obviated by sealing the entire leak within the composition case.



KICO *Storage "B" Batteries Give Long Service at Low Cost*

Alkaline type, will not sulphate or buckle. Not harmed by short-circuiting, overcharging, or standing idle. Panel switches afford single cell variations. Easily recharged from any 110-volt A. C. line by means of small home rectifier. One charge lasts three to six months in detector plate circuit.

				(With Plain Panels)
Prices without rectifier	16 cell	22 volt	$5.50	
	24 cell	32 volt	$7.25	$11.75
	36 cell	48 volt	$9.50	$14.00
	50 cell	68 volt	$12.50	$17.00
	78 cell	100 volt	$17.50	$22.50
	108 cell	145 volt	$23.50	$28.50

Unmounted rectifier $1.00
Mounted rectifier $2.50

SATISFACTION GUARANTEED

Money is refunded if user is not satisfied after 30 day trial. Write for full information on "A" and "B" Batteries.

KIMLEY ELECTRIC CO., Inc.
1359 Fillmore Avenue Buffalo, N. Y.

STANDARD EQUIPMENT

PRICES?

Can U Beat 'Em?

Every item is guaranteed highest grade and perfect or money refunded.

	Regular	Our Price
Magnavox, R-3	$45.00	$34.50
WD-11 Peanut Tube—Socket Free		6.50
Cunningham Detector Tubes.		5.00
Cunningham Amplifier Tubes		6.50
With each Cunningham tube purchased we will give free 1 bakelite base, metal neck socket and 1 high grade rheostat.		
Baldwin Phones	$12.00	$ 9.25
Western Electric Aviation Type Army Phones with Headbands Guaranteed New Stock. A Remarkable Value at the price of		8.00
11 Plate Variable Condensers	3.00	1.45
23 Plate Variable Condensers	3.50	1.50
43 Plate Variable Condensers	4.50	1.75
Large Size Tapped "B" Battery 22½ Volt	3.00	1.75
Large Size Tapped "B" Battery 45 Volts	5.00	3.00
All-American A. F. Transformers Shielded 10 to 1	4.75	3.35
All-American A. F. Transformers Shielded 5 to 1	4.75	3.35
All-American A. F. Transformers Shielded 3 to 1	4.50	3.25
Erla Radio Frequency Transformers	4.00	2.95
Carter Radio Jacks—Open Circuit Jack	.70	.50
Closed Circuit Jack	.80	.60
Double Circuit Jack	.90	.70
Filament Control 4 Spring	1.00	.80
Filament Control 6 Spring	1.10	.90
High Grade Filament Rheostats	.75	.45
Moulded Variometers	5.50	3.75
Moulded Variocouplers 180 Degree	4.50	3.25
Freshman, Micon, etc.	30% off list	
Switch Lever—Tapered Knob	.40	.17
Switch Points—Special at	Per Dz.	.10
Switch Stops—Special at	Per Dz.	.24
Guaranteed Radiocite Mtd.	.30	.20
Guaranteed Million Point Mtd.	.30	.20
3" Bakelite Dial	.75	.45
Tone Tested Mtd. Galena	.30	.20
Grewol Crystal Detector	2.00	1.65
Federal No. 226W. Transformers	7.00	5.25
Triple Honey Comb Coil Mounting	5.00	3.50

SPECIAL SPECIAL SPECIAL SPECIAL TUSKA STANDARD LICENSED REGENERATIVE RECEIVER AND TWO STAGE AMPLIFIER COMPLETE WITH—3 Cunningham Tubes—6 Volt 100 Ampere "A" Battery—2 Large Size "B" Batteries—3000 Ohm Headset—Aerial Equipment—and Arkay Loud Speaker—In Short, Nothing Else To Buy—At The Very Special Price of $100.00

Send Your Order In Today!

Shipments made within 24 hours. Please remit by Express or Postal Money Order. Include postage at your zone rate or shipment will be made by Express.

INDEPENDENT Radio Supply Co.
3239 Ogden Ave.
Chicago, Ill.

Standard Radio Supplies

We offer no cut prices or "junk" merchandise — but we do guarantee you full value for your money, prompt and courteous service, and experienced advice —the result of 15 years in in the radio field.

Send Us Your Mail Orders

Everything in stock that's standard in radio—

Grebe Apparatus—every model always in stock.
Cunningham Tubes—all Types.
WD-11 Tubes, Detector and Amplifier.
Westinghouse Radio Receiving Apparatus.
Frost Fones and other accessories.
Magnavox.
All Radio Corporation of America Receivers.
Remler Radio Mfg. Co.—full line of parts.
Baldwin Phones—all models.
Tungar and Homcharger Rectifiers.
Atwater-Kent Radio Parts.
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And Others too Numerous to Mention!

Coast Radio Company
Incorporated
EL MONTE, CALIF.

TUNE-IN ON THE NATIONAL

WAVE LENGTH AND SAVE MONEY ON YOUR PURCHASES

Lowest Prices on Standard Radio Goods in the U. S. A.

FREE A HYDROMETER (Battery Tester) with each purchase of $1.00 or over **FREE**

HAVE YOU ENTERED OUR ADVERTISING PRIZE CONTEST?

FIRST PRIZE

$250.00 Radio Set Free—Six Tube Radio-Audio Frequency Set

SECOND PRIZE

$150.00 Radio Set Free—Four Tube Set, Detector and 3 stages Amplification

THIRD PRIZE

$100.00 Radio Set Free—Three Tube Set, Detector and 2 stages Amplification

To advertise our business we will give the above prizes to the three persons sending us a list of five or more names of Radio fans and who compose the best slogan or phrase of words we can use for our advertising matter. We are interested in sending our catalogue and price lists to Radio fans.

If you are interested in Radio and in its future possibilities don't overlook this opportunity to get acquainted with us, secure low prices on your purchases and an opportunity to win one of the above prizes free of charge.

In the event of two or more persons submitting the slogan judged the best, second best, or third best, each will receive the full amount of the prize tied for. All entries must be received by us not later than April 30, 1923.

Our Peanut Tube Does the Work of WD-11

For Detector and Amplifying uses. Can be used on 1½ volt dry cells or regular 6 volt A Batteries. Fits standard V.T. socket. Uses about 1/10 ampere, on two 1½ volt dry batteries. Price of tube, $2.50, includes adapter.

1½ VOLT TUBE (not WD-11, but for same use). For detector and amplifying uses. Used on 2 Dry Cell batteries (1½ volt).....$5.00

THIS WEEK'S SPECIALS

1,000 HEADSETS, $6.00 Value.....$2.99 each

Biggest Radio Bargain Ever Offered—Order Promptly

200 CRYSTAL SETS, $12.50 Value.....$6.50 each

Includes Receiving Set and All Antenna Equipment (no phones)

VACUUM TUBES

U. S. Navy (Pliotron) used as a detector, amplifier and transmitting tube, all in one, type V. T. 14	List $8.00, now $4.00
U. V. 200 Detector	4.25
U. V. 201 Amplifier	5.25
U. V. 201-A Amplifier	8.50
WD-11 1½ Volt	6.50
Cunningham Detector	4.25
Cunningham Amplifier	5.25
Myers Audion High-Mu	4.50

Vacuum Tubes Repaired. Broken and burned out tubes repaired. Mail them parcel post insured. Price, $2.75 each, cash with your order. Tubes returned by Parcel Post, prepaid. We guarantee them to burn equal to new tubes.

VERNIER CONDENSERS

11 Plate	List $4.00, now $3.00
23 Plate	" 5.00, " 4.00
43 Plate	" 6.50, " 5.00
Freshman Grid Leak and Condenser for Flewelling Circuit	" 1.00, " .75

TRANSFORMERS

Thordasen	List $4.50, now $3.00
Atwater Kent	" 5.00, " 3.75
Acme	" 5.00, " 3.75
WD-11	" 5.00, " 3.75

BUS BAR WIRE—6 two-foot lengths.....$0.25

DX TRANSFORMERS, $9.00 Value, Special.....6.50

HEADSETS

2200 Ohm, equals best $8.00 phones on market, now	$4.50
Brandes—2000 Ohm	5.50
Dictograph	$5.80
Federal	5.30

HOW TO ORDER

All goods forwarded by Parcel Post. Send Money Order with order, and include the following rates with same for postage:

On Purchases $1.00 to $5.00, 6 Cents Postage
On Purchases $5.00 to $10.00, 15 Cents Postage
On Purchases $10.00 to $20.00, 20 Cents Postage
On Purchases $25.00 to $50.00, 35 Cents Postage

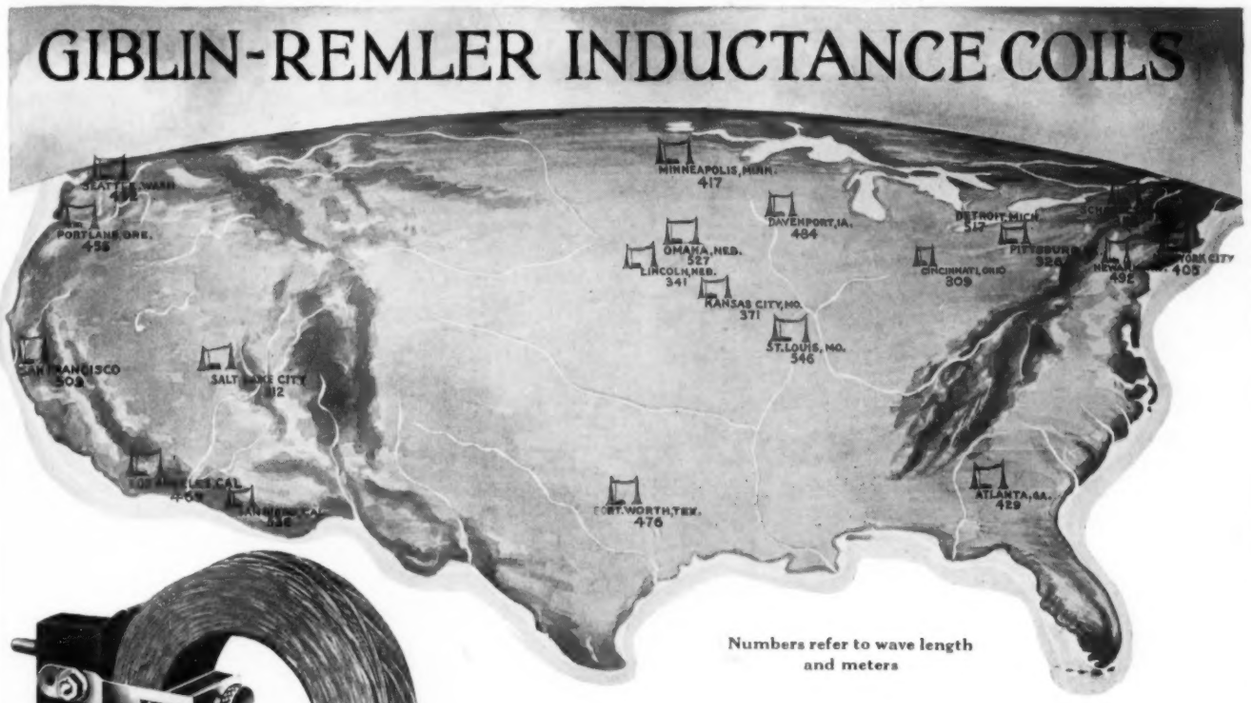
Space being limited, we are obliged to omit other money-saving items. Write for quotations or ask for our latest Price Sheet Catalogue.

National Radio Products Corporation

Mail Order Dept., 509 FIFTH AVENUE NEW YORK

Tell them that you saw it in RADIO

GIBLIN-REMLER INDUCTANCE COILS



Numbers refer to wave length and meters

Interchangeable with all Coil Mountings.

—the basic and correct system for receiving over the entire range of broadcast wave lengths—228-546 METERS

Under the new assignments recently made by the U. S. Government, radio stations are now broadcasting on wave lengths ranging from 228 to 546 meters. It is, therefore, necessary that your receiving set operate efficiently over this entire range of wave lengths. For this purpose sets using Giblin-Remler coils are ideal. As shown in the table when using condensers of .001 microfarads capacity a single set of coils may be selected that will satisfactorily cover this entire range.

Type and Number of Turns, Mounted	Price, Mounted	Type and Number of Turns, Unmounted	Price, Unmounted	Inductance in Millihenrys at 1000 cycles Accuracy 1½%	Natural Wave Length in Meters, Accuracy 1½%	Distributed Capacity, in micro-micro-farads, Accuracy 1%	Wave Length Range in Meters using Condenser of .001 max. and .00004 mfd. min.		High Frequency Resistance in Ohms at Wave Length shown.			
							Min.	Mas.	200	500	1000	2000
RG 20M	1.50	RG 20U	.70	.030	39	14.3	63	334		1.1		
RG 25M	1.50	RG 25U	.70	.041	47	15.2	75	389		1.5		
RG 35M	1.50	RG 35U	.70	.083	87	25.4	128	550		3.5		
RG 50M	1.60	RG 50U	.80	.169	114	21.6	185	785		8.8	4.4	
RG 75M	1.65	RG 75U	.85	.377	163	19.8	266	1170		28.3	12.1	6.2
RG 100M	1.70	RG 100U	.90	.666	217	19.9	358	1550		80.3	26.8	12.6
									1000	2000	5000	10000
RG 150M	1.75	RG 150U	.95	1.503	281	14.8	512	2320	69.8	23.8	7.1	
RG 200M	1.80	RG 200U	1.00	2.68	374	14.7	690	3110		50.6	12.5	
RG 250M	1.90	RG 250U	1.10	4.20	424	12.1	860	3880		87.5	19.9	
RG 300M	2.00	RG 300U	1.20	6.11	494	11.2	1030	4680		141	29.3	13.8
RG 400M	2.10	RG 400U	1.30	11.04	618	9.7	1380	6300			54.6	22.3
RG 500M	2.30	RG 500U	1.50	17.50	747	9.0	1730	7900			93.1	34.9
									2000	5000	10000	20000
RG 600M	2.40	RG 600U	1.60	29.2	1024	10.1	2260	10250		111	43.8	
RG 750M	2.65	RG 750U	1.85	39.0	1249	11.3	2660	11850			64	
RG1000M	3.40	RG1000U	2.50	71.6	1620	10.3	3570	16000			123	
RG1250M	3.80	RG1250U	2.90	108.0	1930	9.7	4380	19700				
RG1500M	4.40	RG1500U	3.50	159.8	2300	9.3	5300	23800				

These tests have been made by Robert F. Field of Cruft High Tension Electrical Laboratory, Harvard University, Cambridge, Mass.

In addition to this novel feature the Giblin-Remler coils, due to their special winding, have *maximum inductance and minimum distributed capacity* for a given number of turns. These two important electrical features insure *maximum selectivity and greatest signal strength* under any given condition.

The use of Giblin-Remler coils also insure greatest possible flexibility. By merely changing one or more of the coils your set may be made to cover any desired range of wave lengths.

Write for Bulletin R giving complete information, table of constants and prices on Giblin-Remler coils.

REMLER RADIO MANUFACTURING COMPANY

Factory and Home Office
248 First Street, San Francisco, Cal.

Eastern Sales Office
154 W. Lake Street, Chicago, Ill.

"THE "WRIGHT" WAY WINS THE RIGHT OF WAY"

WRIGHT RADIO PRODUCTS — RADIO CENTER

WRIGHT RADIO PRODUCTS — RADIO CENTER

This Trade Mark stands for the highest degree of engineering skill in Radio Manufacturing

Manufactured by the Radio Shop Sunnyvale Calif. under Armstrong U. S. patent No. 1,113,149 and U.S. application No. 807,388.

Model "A" Regenatone Complete

Including tubes, batteries, phones and antenna material, ready to operate,

$115

Other combinations of loud-speakers and tubes on request.

The *"Wright"* Idea of Radio

EVERY feature of fine Radio receiving sets has been utilized and combined to create the Model-A REGENATONE. All distortion and body capacity effects have been eliminated by special circuit arrangement and mechanical design. Vernier control and two main adjustments insure simple and perfect tuning.

These features make Radio education unnecessary and guarantee wonderful results to amateur Radio enthusiasts.

We gladly stand behind the REGENATONE with the WRIGHT-RADIO products guarantee

A San Jose user of the Model A REGENATONE reports nightly reception from Canada, Los Angeles, Portland, Denver, Salt Lake: with occasional reception from Davenport, Iowa: Kansas City, Saint Louis and Havana, Cuba.

A Denver user of the Model A REGENATONE reports reception from nearly every class B station in the United States, besides Cuba and Canada.

This is the very set the country dwellers have been waiting for.

With it they are able to receive weather reports for crop protection, market reports, news reports daily, and in the evening they can enjoy the high class entertainments broadcasted from the several large Pacific coast broadcasting stations, thus bringing the Grand Opera stars and light opera entertainers directly to their fireside. This is a service you can well afford regardless of your remoteness from the city playhouses and information sources.

Regenatone Model A $75

See your dealer today or write direct to us for the name and address of your nearest dealer.

SPECIFICATIONS

Highly polished and beautifully decorated mahogany cabinet. Well selected and flawless formica panel. Well balanced controls with tapering knobs affording smooth tuning action. Only well selected high grade material used throughout. Circuit arranged so that only two controls necessary. Use of "C" battery self contained gives maximum amplification without the usual distortion. All batteries contained in cabinet when using WD-11 tubes. Using other tubes, storage "A" battery only external. All special conveniences known are incorporated in the design.

THE H. EARLE WRIGHT COMPANY

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